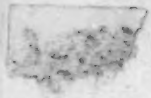
PROCEEDINGS



OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA

FOR

PROMOTING USEFUL KNOWLEDGE.

Public Library,
JUN 30 1892
DETROIT, MICH.

Vol. XXIII.

JANUARY TO DECEMBER, 1886.

PHILADELPHIA:
PRINTED FOR THE SOCIETY
BY M'CALLA & STAVELY.
1886.

RS06 A6
v.23 1886

GI

Subscription Price, $4.00 per Annum; to Members, $1.00.

Entered at the Philadelphia Post-Office as second-class matter.

PUBLISHED QUARTERLY.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XXIII. JANUARY, 1886. No. 121.

TABLE OF CONTENTS.

	PAGE.
A Contribution to the Vertebrate Paleontology of Brazil. By *E. D. Cope* (*with plate*)	1
Some new Hypotrichous Infusoria. By *Dr. Alfred C. Stokes* (*with plate*)	21
Contributions from the Laboratory of the University of Pennsylvania. No. XXIV. Contributions to Mineralogy. By *Dr. F. A. Genth*	30
On Polysynthesis and Incorporation as Characteristics of American Languages. By *Daniel G. Brinton, M.D.*	48
Aus Bosnien und der Hercegovina. By *Dr. Friedrich S. Krauss*	87
Catalogue of the Species of Batrachians and Reptiles contained in a collection made at Pebas, Upper Amazon, by John Hauxwell. By *E. D. Cope*	94
A Sketch of the Life of Robert E. Rogers, M.D., LL.D., with Biographical Notices of his Father and Brothers. By *W. S. W. Ruschenberger, M.D.*	104
Report on the Coal Deposits near Zacualtipan, in the State of Hidalgo, Mexico (*with two cuts*). By *E. D. Cope*	146
Stated Meeting, August 21, 1885	152
Stated Meeting, September 18, 1885	153
Stated Meeting, October 2, 1885	154
Stated Meeting, October 16, 1885	157

☞ It is requested that the receipt of this number be acknowledged.

☞ Members who have not as yet sent their photographs for the Society's album will confer a favor by so doing.

☞ Please communicate any change of address.

PUBLISHED FOR THE AMERICAN PHILOSOPHICAL SOCIETY,

BY

McCALLA & STAVELY,

NOS. 237-9 DOCK STREET, PHILADELPHIA.

EXTRACT FROM THE BY-LAWS.

CHAPTER XII.

OF THE MAGELLANIC FUND.

SECTION 1. John Hyacinth de Magellan, in London, having in the year 1786 offered to the Society, as a donation, the sum of two hundred guineas, to be by them vested in a secure and permanent fund, to the end that the interest arising therefrom should be annually disposed of in premiums, to be adjudged by them to the author of the best discovery, or most useful invention, relating to Navigation, Astronomy, or Natural Philosophy (mere natural history only excepted); and the Society having accepted of the above donation, they hereby publish the conditions, prescribed by the donor and agreed to by the Society, upon which the said annual premiums will be awarded.

CONDITIONS OF THE MAGELLANIC PREMIUM.

1. The candidate shall send his discovery, invention or improvement, addressed to the President, or one of the Vice-Presidents of the Society, free of postage or other charges; and shall distinguish his performance by some motto, device, or other signature, at his pleasure. Together with his discovery, invention, or improvement, he shall also send a sealed letter containing the same motto, device, or signature, and subscribed with the real name and place of residence of the author.

2. Persons of any nation, sect or denomination whatever, shall be admitted as candidates for this premium.

3. No discovery, invention or improvement shall be entitled to this premium, which hath been already published, or for which the author hath been publicly rewarded elsewhere.

4. The candidate shall communicate his discovery, invention or improvement, either in the English, French, German, or Latin language.

5. All such communications shall be publicly read or exhibited to the Society at some stated meeting, not less than one month previous to the day of adjudication, and shall at all times be open to the inspection of such members as shall desire it. But no member shall carry home with

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XXIII. JANUARY, 1886. No. 121.

A Contribution to the Vertebrate Paleontology of Brazil. By E. D. Cope.

(*Read before the American Philosophical Society, April 17, 1885.*)

Professor Orville A. Derby, Director of the Geological Section of the National Museum of Brazil, has desired me to furnish to the museum an account of the extinct Vertebrata from the various strata found within the limits of the Empire, which are preserved in the Museo Nacional at Rio de Janeiro. I have also received a considerable collection made in the neighborhood of Bahia by Mr. Joseph Mawson, of London, England, which has aided me much in the determination of the extinct fauna of that region.

The horizons from which the species now enumerated have been derived are the Pliocene, the Cretaceous and the Carboniferous. The work hitherto done in this field is small in amount. The researches of Lund and Reinhardt into the fossils of the caves of Brazil are well known. Professor Owen has determined the existence of Crocodilia and Dinosauria in the Cretaceous beds near Bahia; and Professor Marsh has described a gavial from the same horizon and locality. Professor J. S. Newberry has identified some fishes from Ceara in Eastern Brazil as of Jurassic age; and I have described a genus and species from the same locality. In more detail, the localities and horizons from which the specimens of vertebrate fossils of the Museo Nacional have been derived, are the following, so far as determined:

PLIOCENE, *Pampean.*

North-eastern pt. of Province of Bahia; *Toxodon expansidens*, sp. nov.

CRETACEOUS ? *Laramie.* Near Bahia. *Diplomystus longicostatus*, sp. nov. *Chiromystus mawsoni*, sp. nov.

Fox Hills. Province of Pernambuco. *Hyposaurus derbianus*, sp. nov.;

Enchodus subæquilateralis, sp. nov.; *Galeocerdo pristodontus* Agass.; *Apocopodon sericeus*, sp. nov.

?————. Province of Sergipe del Rey. *Pycnodus flabellatus*, sp. nov.

JURASSIC. Province of Ceara. *Anædopogon tenuidens* Cope. *Aspidorhynchus*, sp.

CARBONIFEROUS. Province of San Paolo. *Stereosternum tumidum*, sp. nov.

The following pages contain the detailed descriptions of the new species, and the determination of their affinities. Others yet remain to be determined.

PISCES.

APOCOPODON SERICEUS, gen. et sp. nov. Myliobatidorum.

Char. gen. Founded on teeth which formed a pavement like that of Myliobatis, but which are mostly separated in the specimen. These consist of longer ones of a median series, and smaller ones of the lateral series. The teeth of the median series are shorter than in the typical forms referred to Myliobatis, having rather the proportions characteristic of Zygobatis. They differ from the corresponding teeth in both genera in being exactly parallelogrammic in outline; that is, the extremities are truncated instead of angulated as in those genera.* The lateral teeth display the usual angulation among themselves, though doubtless joined by a straight suture to the middle row. The roots are well distinguished from the crowns, and are short. Their grooves are very shallow, or merely indicated. The triturating surface is covered by a dense layer which is wrinkled like the sides of the crown, and is continuous with it.

Char. specif. The teeth are robust and indicate a species of considerable size. The crowns are considerably more elevated than the roots, and have perpendicular sides. The sutural surfaces are straight, and marked by fine grooving which runs at right angles to the grinding face, and is continuous with the wrinkling of the latter on the long sides of the crown. From this it follows that the wrinkling crosses the grinding face at right angles to its long diameter. There are in the wrinkling six ridges to a millimeter. The roots are constricted from the crowns by a groove, which is itself divided by a narrow collar-like rib, resembling cement, which is expressed on the junction of two pieces by pressure, grown cold. The sizes of the teeth diminish externally. The roots of those of the antepenultimate are crossed by four shallow grooves, and those of the penultimate by two. External row lost. Six grooves cross the root of one of the larger teeth.

Measurements.		M.
Diameters of larger tooth	transverse	.024
	anteroposterior	.013
	vertical	.021
Vertical diameter of root of do		.006

*One end of one of the large teeth has the usual two faces.

Measurements.		M.
Diameters of root of antepenult tooth	transverse.....	.015
	anteroposterior	.010
Diam. of root of penultimate of row	transverse.....	.007
	anteroposterior..	.010

From Maria Farinha, Province of Pernambuco. Probably of Fox Hills or Maestrichtian Cretaceous age. Coll., No. 306.

ENCHODUS SUBÆQUILATERALIS, sp. nov.

This species is represented by a premaxillary bone bearing the long laniary tooth characteristic of the genus, and by another osseous fragment bearing a similar tooth, which may perhaps belong to the distal part of the dentary bone. I describe the first-named specimen. The fragment of the premaxillary is so small that little can be said of it, except that its surface is smooth, and but slightly convex, and that it projects but little beyond the long tooth. The tooth is long and slender, and has a very slight sigmoid fore and aft curvature. It has two opposite cutting edges, the anterior of which reaches to its base, and the posterior for half of its length. The inner face of the tooth begins to be more convex than the external at about the middle of its length, but this convexity is not much marked beyond the basal fourth. The surface of the tooth is smooth everywhere.

This species is readily distinguished from such species as *E. mortoni*, where the edges are not opposite. From the *E. carinatus* and *E. gladiolus*, where the edges are opposite, the smooth surface separates it. In the allied *E. dolichus*,* the posterior cutting edge only extends one-quarter the length of the tooth.

Length of crown M. .022; diameters at middle, long, .004; short, .0023.

DIPLOMYSTUS LONGICOSTATUS, sp. nov.

This herring is represented by numerous specimens, and possesses well-marked characters. These may be stated in general thus: The caudal part of the vertebral column is very short. The abdomen is very deep and the ribs are long. The caudal fin is deeply forked, and has long acute lobes. The other fins are very small.

The scales are so attenuated as not to be countable. The scutes of the median dorsal line are longer than wide, and are emarginate behind, and hence cordate. The superior surface of two of them is roughened with radiating ridges. The inferior surfaces are smooth. None behind the dorsal fin.

The dorsal outline rises gradually to the dorsal fin, and then gradually descends to the caudal peduncle. The general convexity is slight. On the other hand the abdominal convexity is very great, and is especially protuberant below the dorsal fin. The depth at this point enters the total length, minus the caudal fin, one and five-sixth times. The length of the head enters the same three times. The superior surface of the head

*See Report on Cretaceous Vertebrata of the West, E. D. Cope, p. 300.

slopes gently from the dorsal line; hence the pectoral outline is very steep. The head is a good deal injured in the typical specimen, but it is somewhat longer than deep.

The middle of the base of the pectoral fin is half-way between the vertebral column and pectoral border inclusive. The dorsal fin begins along the anterior border of the fourteenth vertebra. It is elevated in front, and, having a short base, has a rapidly descending posterior outline. The anal fin originates much behind the posterior border of the dorsal. It is also short and weak. Formula, D. 10; C. + 18 +; A. 8. Vertebræ, Abd. 24; C. 10; only one included between the external caudal rays. Neural and hæmal spines weak and rather short. Ribs long and robust. Abdominal scuta rather large, and with a free posterior accumination. The supplementary ribs, if they ever existed, are not preserved. Ventral fins lost from the typical specimen.

Measurements.	M.
Total length (axial)	.126
Length to basis of caudal fin	.096
Depth at free edge of operculum	.044
" " " " " dorsal 1st ray	.055
" " " " " anal " "	.020
Length of dorsal fin { in front	.016
Length of dorsal fin { on base	.014
Length of anal fin { in front	.007
Length of anal fin { on base	.010
Length of a caudal lobe from base	.035
" " abdominal vertebræ	.056
" " caudal "	.020

The specimens are from the coast near Bahia. The type comes from near Itacaranha, where it was found by Mr. Joseph Mawson. Other specimens are from the same locality, while others are from Plataforma and Agua Comprida. In none but the type do I find the dorsal scuta preserved.

This genus has hitherto been only known from the Lower lacustrine Eocene of North America. Its occurrence in this supposed marine formation indicates that, like its close ally *Clupea*, *Diplomystus* has considerable range in time and space. The *D. longicostatus* falls into the section of the genus represented by *D. humilis* Leidy. From this and the allied *D. altus*, it differs in the more numerous abdominal and less numerous caudal vertebræ, and the longer lobed more deeply furcate caudal fin.

CHIROMYSTUS MAWSONI, gen. et sp. nov.

This new genus and species are indicated by a single large specimen from the same horizon as the *Diplomystus longicostatus*. It is nearly complete, with the important exception that the head and a few anterior dorsal vertebræ are wanting. The impression of the scapular arch, however, gives the position of the skull, and the anterior ribs give a clue to the

character of the anterior dorsal vertebræ. From these it appears that the genus is Isospondylous and not Plectospondylous.

Char. gen. Dorsal fin small, above the anal, which is moderate. Pectoral fin with several superior rays thickened and robust. Caudal fin furcate. Ventrals small. No ventral or dorsal scuta. Scales much attenuated. No basilar interneurals or hæmals.

This genus may belong either to the *Hyodontidæ* or *Chirocentridæ* so far as the characters given by authors are concerned, since the only distinctions given are found in the soft parts. I have pointed out * that the parietals are in contact, and the caudal fin embraces two vertebræ in the *Hyodontidæ*, while in the *Chirocentridæ* the parietals are separated by the supra-occipital, and there is but one caudal-fin vertebra as in the *Clupeidæ*. I can only observe the caudal fin in *Chiromystus*, and find that it includes two vertebræ, as in the *Hyodontidæ*.

Char. specif. The form is rather elongate. The depth of the longest ribs, and vertebra corresponding, enter the length, exclusive of the head and caudal fin, four and a third times. Vertebræ, Abd. 28; C. 22. The anterior dorsals are obtained by counting the ribs, and three are added to the caudals visible, in order to fill up an interruption caused by fracture. The centra are longer than deep, and have two lateral longitudinal fossæ, bounded above and below by a narrow rib, and separated by a flattened rib.

The posterior part and apex of the dorsal fin are wanting, so that its characters cannot be given, except by stating that the rays are slender and weak. The anal fin is injured at its posterior extremity, but by counting the interhæmal bones I find the rays to number sixteen. The four superior pectoral rays are very robust, the inferior most so. The three upper are preserved, and it can be seen that they are compressed and smooth, and not segmented. The caudal fin is very deeply forked, and the lobes are long. Each one consists of six strong external rays, besides the fulcral rays, and a number of very fine rays on the inner side of these, giving each lobe a narrow form. The scales are extremely attenuated, and cannot be counted. The ventral fins are quite small, and the rays may not all be preserved, although those that are visible are in place. They number only four.

Measurements.	M.
Length of vertebral column	.310
" " a lobe of the caudal fin	.100
" from base of ventral to base anal	.081
" " " " anal to base caudal	.085
" " " " dorsal to base caudal	.063
" superior spine pectoral fin	.065
" of ventral fin	.027
Diameters of last abdominal vertebra { longitudinal	.008
Diameters of last abdominal vertebra { vertical	.0075

* Proceedings Amer. Assoc. Adv. Sci., Vol. xx, p. 333.

The specimen was obtained near Agua Comprida, near Bahia, by Mr. Joseph Mawson. I dedicate the species to him with much pleasure, in recognition of the valuable service rendered by his collection in the present investigation.

PYCNODUS FLABELLATUS, sp. nov.

A slab of limestone contains a skeleton of this fish, but the latter is in several points imperfect. The head anterior to the orbit is wanting, and the superior half of the anterior dorsal region is broken away. The ventral fins are lost. Some isolated teeth are of the proper size to belong to this species, and will be mentioned later.

The outline of the profile of the body is discoidal, and the axis of the skull (vomer, etc.) is directed obliquely downwards at an obtuse angle with the vertebral column. This requires an extensive production of the operculum above and posterior to its articulation with the hyomandibular. The clavicle is slender, while the coracoid is produced backwards below the pectoral fin, its superior border being concave to the first rib, which is overlapped by the posterior edge. The coracoid also extends downwards and forwards as usual. The four basilar bones of the pectoral fin are rod-like, and are moderately expanded distally. The determination of this point is of much importance in fixing the position of the *Pycnodontidæ* in the system. The basis of the dorsal and ventral fins descend steeply downwards to a narrow and very short caudal peduncle. The caudal fin is of characteristic form. Its lobes are long, but they diverge so widely that the posterior edge of the fin is slightly convex from tip to tip. Radii, D. 53; C. 3 + 40 + 2; A. 24.

The constitution of the vertebral column is not easy to make out. Only the anterior half is preserved. This displays the usual superior and inferior plates. In the present species the edges of these are in contact, so that the condition of the centrum, if there be any, as to ossification, is not positively determinable. The neural spines above their basal expansions are connected by a series of longitudinal teeth which interlock closely so as to resemble a series of ribs. On examination it is found that half of these originate from one neural arch, and half from the other, there being six or seven in all. A slight protuberance, probably for the rib-head, appears 3 mm. below them. The true ribs are broadly alate, so as to form a continuous wall. The rhabdopleurs agree in number with the vertebræ, and are present to the end of the vertical fins. On the caudal region they extend downwards .66 the length of the hæmal spines. The latter extend to the superior apices of the interhæmals. The rhabdopleurs are not segmented as is represented in some species of this family. The caudal fin includes one or two vertebræ. There are two short, widely expanded hypurals, much as in *Physoclystous* fishes where they are distinct. Vertebræ, D. 19; C. 15 or 16.

Measurements.	M.
Total length to anterior edge of orbit	.172
Longitudinal diameter of orbit	.016

Measurements.	M.
Distance from orbit to free edge of operculum	.022
Length of vertebral column	.116
Diameters of caudal fin { anteroposterior	.027
Diameters of caudal fin { vertical	.093
Depth above rib-heads at front of dorsal fin	.055
" below hæmal plates, front of anal fin	.044

The teeth preserved are loose medians, and perhaps laterals, but the reference of the latter is uncertain. The crowns of the former are a little more than twice as wide as long, and have the extremities a little oblique. The summit is a little flattened, and the sides project a little beyond the base. The surface smooth. Length, M. .010; width, .0045.

The peculiar form of the caudal fin distinguishes this species from most of the known members of the family *Pycnodontidæ*. The feeble dorsal and anal fins distinguish it from others, and the discoidal form from still others.

The structural characters observed in the specimen described have been instructive, especially those of the pectoral fin. These confirm altogether my reference of the family of the *Pycnodontidæ* to the *Isospondyli* as distinguished from the *Halecomorphi*.*

The typical and only specimen of this species in the collection is from the southern centre of the Province of Sergipe del Rey. It is on a slab of cream-colored calcareous rock which has a coarse slaty cleavage, and probably belongs to the Cretaceous formation, and is of marine origin.

? BATRACHIA.

STEREOSTERNUM TUMIDUM, gen. et sp. nov.

Char. gen., etc. This genus is known from numerous vertebræ and ribs, sometimes forming consecutive series, but more frequently isolated; but especially from two slabs, which exhibit the posterior part of a skeleton; *i. e.*, dorsal vertebræ and ribs, pelvis and posterior limbs, and caudal vertebræ.

The dorsal vertebræ present some of the general characters of the reptiles and batrachians of the Permian period. One of these is the existence of a notochordal canal. The small size of the vertebral centrum as compared with the arch and its appendages constitutes a resemblance to the batrachian class; as also do the horizontal position and weak development of the zygapophyses. On the other hand the simple articulation of the ribs resembles that of the Lacertilia in general, though not of any known group of that order; and has no resemblance to any known reptile of the Carboniferous period.

The vertebral articular surfaces are both funnel-shaped, the anterior deeply, the posterior shallowly excavated. The dorsal centra are undi-

* On the classification of the Extinct Fishes of the Lower Types. Proceeds. Amer. Assoc. Adv. Science, 1878, p. 292.

vided, and the notochordal canal is small. The caudal vertebræ have a groove, more or less obliterated by coösification, surrounding the middle of the centrum, and cutting off a part of the base of the neural spine above. This looks as though the genus possesses intercentra, which were primitively separated by the protovertebral fissure. The posterior part of the centrum carries chevron bones, which are distinct from it. Besides the zygapophyses, there is, in the dorsal vertebræ, a modified form of zygosphen, though there is no zygantrum. The former consists of a roof-like projection of the neural arch above each prezygapophysis, which is applied to the superior surface of the postzygapophyses. In some of the vertebræ, this zygosphenal roof is horizontal; in others it is slightly oblique, rising outwards on each side, in the manner of a true zygosphen. It differs further from a true zygosphen in being fissured vertically, above the neural arch, but there is no corresponding process of the adjacent vertebra to occupy it. On the contrary there is a corresponding fossa of the posterior side of the vertebra in front. These fossæ may be points of insertion of ligaments which strengthen an articulation otherwise weak.

The ribs appear to be coössified with the centra, so that it is difficult to say whether they are truly ribs or diapophyses. In one specimen, the proximal ends of the ribs are seen to be expanded, and applied to the centrum so as to embrace it. These expanded extremities are simple and are separated on the median line of the centrum by a narrow space. Others are not so expanded proximally, but contract to their connection with the centrum. In some of the centra each side is produced into a depressed conical apex in the position of a diapophysis. The position of these vertebræ is uncertain. The ribs are long, cylindric, curved and remarkably robust, having characters like those of the genus Ischyrosaurus of the Laramie formation, or of Mesosaurus of Gervais. They could not have had any movement on the vertebræ.

The scapular arch is represented by a coracoid bone, which though isolated, is lying on a slab with numerous remains of this genus. As no other form is represented on the slab, I suppose the coracoid to belong to Stereosternum. It is expanded fore and aft, most so posteriorly, and possesses a supracoracoid foramen. Its internal border presents a deep notch opposite the glenoid cavity.

Portions of several humeri are preserved. They demonstrate either that the head is subround, or that if expanded it is at right angles to the distal end. The latter is perforated near one of its borders by an epicondylar foramen, but whether entepicondylar or ectepicondylar, I cannot ascertain. The opposite foramen is represented by a shallow groove at the distal end of the opposite side. There are no well marked condyles of the humerus.

The head of the femur is truncate and subround, and without trochanter. The shaft is subround and is of considerable length. There are no distinct condyles, but the articular surface is convex anteroposteriorly. The tibia is a stouter bone than the fibula, and its distal extremity is ex-

panded outwards. Its tarsal articular suface forms an acute angle with the long axis of the shaft, presenting outwards. It has besides a slight distal transverse truncation. The fibula has a robust head and is slender distally. The tarsus consists of seven bones. These are a tibiale, an intermedio-centralo-fibulare, and a tarsale corresponding to each of the five metatarsals. There is a foraminal notch on the internal edge of the intermedio-centralo-fibulare, next to the tibiale. The bones of the foot beyond the tarsus are well distinguished from each other. The metatarsals are rather slender, and are considerably longer than the phalanges of the first row. The phalanges are not much shortened, but diminish in length regularly to the end. The ungual phalanges are not preserved in a perfect condition on any of them. The proximal portion remains on the second digit, and it is depressed, offering no indication of a claw. The first toe is not shortened, and appears to be longer than the second. Its distal segments are lost. Neither the metatarsals nor the phalanges have distinct condyles, but are truncate in the vertical direction.

Abdominal protective armature is present in the form of osseous rods. Several of these rods form a single girdle. They are not connected with the ribs.

The pelvis is partially preserved in the specimen on the slab. Both pubes and ischia are well developed, and if there is any obturator foramen it is very small and median in position. It probably does not exist, but I am precluded from certainty by the condition of the specimen at the point of crossing of the median and transverse sutures. The pubis is not so large as the ischium, and has a foramen near its posterior border. The ilia have less transverse, and greater longitudinal expanse than the pubes, and are in contact on the middle line throughout most of their length.

Affinities. It is not easy to decide as to the position of this genus. While many of its characters are reptilian, some of them are batrachian. Of especial interest in this connection is the structure of the pelvis. Its characters are only like those of some of the Urodele Batrachia, and the Theromorphous Reptilia. It is, however, quite certain that it does not belong to any known family of either class. The vertebræ might be those of a Theromorph reptile, and the pelvis also agrees with that of those animals. The abdominal rods are found in species of that order referred to the genus Theropleura. The ribs and tarsus are however of an entirely different type. The former would refer the genus to the Rhynchocephalia or the Sauropterygia, and there is nothing known in its structure which positively forbids either reference, unless it be the character of the pelvis. It differs from the types of the Batrachia which it most resembles, the Protonopsidæ, in the replacement of the cartilaginous plate which represents the pubis by two osseous plates. It presents a near resemblance in important characters to the genus Ichthycanthus* which

* I refer to the *Ichthycanthus ohiensis* from the description and from memory, as the specimen is not at present accessible. The *I. platypus* is one of the Rhachitomi, and has in the tarsus, astragalus, calcaneum, navicular, and five distinct tarsals of the second row.

PROC. AMER. PHILOS. SOC. XXIII. 121. B. PRINTED SEPTEMBER 26, 1885.

I described from specimens procured by Professor Newberry, in the coal measures of Linton, Ohio.* The peculiar structure of the tarsus is identical as to the number of its elements, and the other characters agree in general. There are important differences also, which would refer Ichthycanthus to another family. Thus the dorsal vertebræ have the centra deeper than long, and the ribs are free. In the absence of the skull, it is not possible to be sure as to which of the classes, Reptilia and Batrachia, these genera represent.

Another form presents some important points of resemblance; that is the genus Mesosaurus of Gervais.† The *M. tenuidens* Gerv. was brought by Verreaux from an undetermined formation of Griqualand, South Africa. The specimen, like that of the *Stereosternum tumidum*, is exposed on a slab, and embraces only the head, neck, thorax and anterior limbs. As the dorsal vertebræ are obscured by matrix the only point in which actual comparison can be made is the ribs. These are quite identical in the two types, but the articulations with the vertebral centra are invisible in the Mesosaurus. There are apparently impressions of abdominal dermal riblets, but they are suspected by Gervais to be the tracks of Annelids. Gervais thinks the skull has but a single condyle. The scapular arch consists of coössified scapula and coracoid, but clavicle, præsternum and sternum are not visible. The coracoid is different in form from that of Stereosternum. The humerus is, on the other hand, almost identical, and the carpus is nearly what one would expect to find in the Brazilian form. There are in the first carpal row, two large bones, and in the second, four small ones.

Habits.—The structure of the limb articulations and those of the elements of the posterior foot show that this was a genus of aquatic habits. The firm attachment of the ribs shows further that this type had no intercostal respiration, but used its sublingual or its abdominal muscles, or both, in the act of inhaling air. We may suppose that in its aquatic habitat it retained air in the lungs for considerable periods, and only respired on reaching the surface of the water; or later investigation may show that it is branchiate.

Geological position.—The peculiar characters of this form and the difficulty of determining its true position in the system, present an obstacle to the interpretation of its probable geological age. It has a good many resemblances to the suborder Choristodera of the order Rhynchocephalia (represented by the Champsosauridæ). This type first appears in the Laramie or latest Cretaceous, and continues only to the top of the lower Eocene. The order Rhynchocephalia is an unsatisfactory one for geological purposes. It still exists in one genus, the Hatteria of New Zealand, and may have existed in the Trias; although this is not certain.

Prof. Derby informs me that some specimens of Schizodus have been found in the same beds, and he therefore infers that their age may belong

*Proceedings Amer. Philosoph. Society, 1887, p. 573.
†General Zoölogy and Paleontology.

to the Coal Measures or to the Permian. There is nothing in the characters of the genus Stereosternum to contradict such a supposition. The primitive characters of various parts of the skeleton and the obvious resemblances to Ichthycanthus, add probability to such a view.

Specific characters.—These may be first drawn from the specimen of the slab already alluded to.

The relative length of the body is not certainly known, as it is only partially preserved in the specimens sent by Prof. Derby. To judge from the one above referred to, it has the ordinary proportions of a lacertilian. The hind legs are well developed, as for example in an Iguana. The tail is well developed, but its length is not determinable as the distal portions are lost.

In the slab specimen the dorsal vertebræ are split or otherwise damaged, so that I describe them preferably from other specimens. The few that are well preserved show characters identical with the latter. I derive the following however from the slab specimen. The dorsal vertebræ have the neural spines well developed but not much elevated. In profile their vertical diameter is about equal to their anteroposterior, and the superior border is squarely truncate. They diminish in height posteriorly. The spines are present at the lumbar vertebræ. The shafts of the ribs have a round section. The proximal portions are for a short distance abruptly incurved to the vertebral body. The distal extremity is pointed. The tissue is dense, and there is no medullary cavity. In the lumbar vertebræ the rib is much more slender, and is shorter. It is coössified with the centrum. The caudal vertebræ have strong diapophyses, which are acuminate and depressed. In the anterior caudals they are recurved at the extremity, but shorten rapidly posteriorly and are transverse. In the specimen they are all separated from the centrum by a fissure which appears to be too constant and too regular to be regarded as a fracture. I suspect therefore that the diapophyses are free, and are joined to the centrum by a simple truncate head, which has an outline nearly round. This view is confirmed by the presence on each side of the centrum of the median caudal vertebræ, of a bone which resembles the sesamoids of the feet of Mammalia, which is quite free from the centrum, and is applied longitudinally to its anterior half. It is probably the rudimental diapophysis. The posterior caudals have no diapophyses. The latter are the only ones in the specimen which are well preserved.

The bodies of the caudal vertebræ have a low ridge in the place of the fissure which is seen in some other specimens to divide them into equal anterior and posterior halves. The entire centrum is longer than deep or wide, and is a little deeper than wide in section. The neural arch is divided into two parts by the characters of the surface. The anterior half is swollen and roughened by minute pits, and is separated from the less prominent posterior half by a pair of small fossæ, one above the other. The neural spine stands entirely on the posterior half, and is thus widely removed from the prezygapophysis, which is above the anterior border of

the centrum. The neural spine is slender and rather elevated, and is subcylindric at the base, and has a narrow compressed apex, with rounded extremity. The chevron bones are quite slender.

The shaft of the femur is nearly straight, and its distal half is moderately compressed from before backwards. The tibia is generally flattened. Its interosseous border is shorter than its internal border, and is strongly concave. The internal border is gently convex. The shaft is narrower than the proximal end, which is narrower than the distal end. The fibula has an enlarged subtriangular head. The shaft is gently curved, the concavity being, as in the case of the tibia, on the interosseous side. The intermedio-calcaneum, or, according to Baur's view, the astragalocalcaneum, is much the largest bone of the foot. It has a truncate side in contact with the tibia, and a concave interosseous border. The rest of the outline is convex, with a slight truncation for the fibula, and one between the tibial border and the posterior notch. The greatest extent of the bone is transverse, and the greatest longitudinal diameter is in line with the fibula. The tibiale has a T-shaped outline, but the spaces below the transverse extremity and the shaft are filled to the truncate narrower extremity of the shaft. The wide end also has the angles rounded off. The tarsals of the second row are longitudinal wide ovals, excepting the first, or internal, which is round.

The extremities of the metatarsals are depressed ovals, and are wider than the middle of the shafts. The phalanges are more depressed. The metatarsals and phalanges of the fifth digit are the shortest, and the lengths of these elements steadily increase to the first. The phalanges of the first digit are lost excepting the first; and the ungual phalanges of the third, fourth and fifth are wanting. Adding the latter, we have the following number of phalanges for the digits from the second to the fifth conclusive, 4–4–4–3.

The anterior border of the pubes is concave, leaving a lateral convex border in front of the acetabulum. The pubes of opposite sides meet at an entrant right-angle. The external posterior angles of the ischia are rounded and prominent, since the posterior borders are oblique and meet each other at a deep entrant right-angle.

Measurements of slab specimen.	M.
Length of a series of five consecutive dorsal vertebræ.	.041
Length of second of this series	.007
Elevation " " "	.015
Length of neural spine of do.	.0065
Elevation " " " to neural canal	.009
Diameters of a vertebra without spine { vertical	.010
transverse	.0105
Diameters of separate centrum of do. { vertical	.003
transverse	.004
Length of chord of a rib; apex restored	.040
Width of shaft of do. at middle	.0035

Measurements of slab specimen.	M.
Elevation of a lumbar vertebra with spine	.017
" " spine of do	.006
Width of centrum at base of ribs	.0075
Length of rib	.0152
Diameters of a pubis { anteroposterior	.014
Diameters of a pubis { transverse	.0176
Diameters of an ischium { anteroposterior	.019
Diameters of an ischium { transverse	.012
Length of femur	.038
Diameters of shaft of femur at middle	.004
Length of tibia	.025
Diameters of tibia { proximal	.005
Diameters of tibia { at middle	.003
Diameters of tibia { distal	.0055
Width of sole, including tibia and fibula	.0125
" " intermediocalcaneum	.009
Length of " at middle	.006
" " tibiale	.007
Width " "	.005
Length " tarsale I	.0038
" " " II	.0040
" " metatarsale I	.0175
" " " II	.016
" " " III	.014
" " " IV	.012
" " " V	.009
" " second digit, minus end of unguis	.036
" " " " first phalange	.0085
" " " " second phalange	.004
" " " " third phalange	.0035
" " ten proximal caudal vertebræ	.075
Transverse extent of diapophyses of second of do	.040
Length of six distal caudal centra	.047
Depth of one centrum of do	.0037
Elevation of neural arch with spine	.0115
" " " " without spine	.003

A number of vertebræ are preserved on fragments of a softer rock of darker color than the specimen above described. It is possible that they belong to another species of the genus, as I observe some peculiarity in the caudal vertebra. The base of the neural spine is so robust as to cover the anterior section of the centrum, and does not therefore present the appearance of coming off from the posterior section alone, as is the case in the typical specimen. I have, however, not seen the arches of the anterior caudals of the latter.

A marked character of the dorsal vertebræ, is the appearance of hyperos-

tosis presented by the neural arch and its parts, and in some degree by the centrum. The outline of the latter viewed from below is barrel-shaped, and the space between the inferior surface of the centrum and the extremity of the diapophysis is filled with osseous tissue, so as to be bounded by a nearly straight line connecting the points in question. The diapophyses, where not continued into ribs, are somewhat flattened cones. The neurapophyses are greatly thickened, having more than twice the transverse diameter of the small neural canal. The zygapophyses are mere ledges; the prezygapophyses of the neurapophyses; the postzygapophyses of the neural roof. The latter is expanded and thickened, an anterior thickening on each side, constituting the zygosphen. The neural spine is moderately a little elevated, and is compressed; its base extending the length of the neural arch. The prezygapophyses are opposite the middle of the neural canal. The postzygapophyses are connected by a thin prolongation of the roof of the neural canal, which is not interrupted in any of the vertebræ at my disposal.

The anterior caudal vertebra is flattened below, and has a median shallow fossa. A large basis for a rib marks the upper part of the anterior half of the centrum, and below it is a low tuberosity. Between the latter, on the ? intercentral half, is a short accuminate tubercle directed forwards. The posterior articular face is supplemented by two facets below, as if for separate chevron bones.

A more posterior caudal vertebra has a longer, and compressed centrum, without transverse processes or tubercles. The inferior surface has a ridge on each side, which are interrupted by the constriction already mentioned. Those of the posterior half are continued into coössified chevron bones. The postzygapophyses are more elevated on the dorsal vertebræ, and the neural spine is robust and is directed strongly backwards.

The surfaces of the dorsal vertebræ are smooth; that of the anterior caudal is minutely punctate, and at some points wrinkled.

Measurements of Vertebræ.

No. 1 (with rib).	M.
Total elevation	.0125
Elevation of centrum anteriorly	.0040
" to prezygapophysis	.0055
" " zygosphen	.0070
" " highest base of neural spine	.0090
Width of centrum anteriorly	.0035
" " prezygapophyses	.0090
No. 2 (without ribs).	
Total elevation	.0160
Length of centrum	.0080
Elevation to neural canal posteriorly	.0038
" " postzygapophyses	.0058
" " neural spine	.0100

Measurements of Vertebræ.

No. 2 (without ribs).	M.
Width of centrum posteriorly	.0040
" at diapophyses inclusive	.0180
" " postzygapophyses	.0100
No. 3 (without rib).	
Diameters centrum longitudinal	.0072
Diameters centrum vertical anteriorly	.0035
Diameters centrum transverse anteriorly	.0035
Width at diapophyses inclusive	.0170
" of postzygapophyses	.0094
No. 3; posterior caudal.	
Length centrum	.0070
Width at middle	.0035
Diameters centrum in front vertical	.0040
Diameters centrum in front transverse	.0040
Elevation to postzygapophysis	.0065
Width of neural spine at postzygapophysis	.0065

This species was probably of elongate form. Prof. Derby informs me that he has seen considerable series of consecutive vertebræ. The specimens sent me indicate that the size of the body is about equal to that of the fully grown *Tejus* lizards now inhabiting Brazil.

The specimens are from four localities in the province of Sao Paolo; viz: Rio Claro, Limeria, Itapetininga and Tieté. These localities are a considerable distance apart, and represent the considerable extent of the formation from which the bones have been procured. As a Lepidodendron and a Schizodus have been obtained from the same beds, they are probably of Carboniferous or Permian age.

The specimen preserved on the slab belongs to the private collection of Madam Ribeira de Andrada, to whom science owes a debt of thanks for the opportunity of determining its characters which she has given by lending it to the Museo Nacional.

REPTILIA.

HYPOSAURUS DERBIANUS, sp. nov.

The genus Hyposaurus has been hitherto represented by but one well known species, the *H. rodgersi* Owen, of the green sand of Cretaceous No. 5, of New Jersey. Specimens in my possession demonstrate that the genus Hyposaurus belongs to the Teleosauridæ, and that its nearest ally is the Steneosaurus of St. Hilaire. It differs from Metriorhynchus Meyer, in the presence of distinct lachrymal bones, and in the relatively small size of the prefontals. From Teleosaurus proper it differs in the robust size and vertical directions of the teeth. The orbits are vertical, and the sagittal region is a keel. In the *H. rodgersi* the frontal bone is narrower than in any of the species of Teleosauridæ figured or described by

Deslongchamps. The palatal foramina extend forwards to the line of the posterior maxillary teeth, and the anterior border is rounded, not acute as in most of the species of the family.* The specimens are not sufficiently complete to enable me to state postively the generic distinction from Steneosaurus. In Teleosaurus the vertebral hypapophyses only appear on the first and second dorsal vertebræ, while, as Owen observes,† they are present on many of the dorsals in Hyposaurus. This peculiarity, and the great contraction of the frontal bone, render it very probable that the genus is distinct from Steneosaurus, but the diagnostic character yet remains to be discovered.

The Brazilian Hyposaurus is represented in the collection of the Museo Nacional, by the left malar and quadratojugal bones; by a nearly entire lower jaw; by several vertebræ from the middle and posterior parts of the column; by a humerus; a coracoid bone; and by several dermal bones, all belonging to one individual. There are several isolated teeth of the same animal, and others which probably belong to the same species, as they closely resemble those which are contained in the lower jaw mentioned.

The mandibular rami early unite into a long slender symphyseal portion. There are twenty alveoli in each, and only five of these are in the portion of the ramus which is posterior to the symphysis. The free portion of the ramus is compressed; both of them are broken off from the coronoid region, inclusive, posteriorly. The symphyseal region has a semicircular section, which is a little angulate; that is, is flattened laterally and below. The splenial bones appear on the inferior surface as far anteriorly as opposite to the fourth tooth from the beginning of the symphysis. The teeth have a lenticular section in the posterior part of the series, and the section becomes rounder, that of the first pair being entirely round. All display a more or less distinct cutting edge in front, and one opposite to it on the posterior face of the crown. The enamel surface is marked with rather close, straight, longitudinal ridges on the internal side of the crown. The middle of the external side is quite smooth. The crowns are acute at the apex and slightly recurved. Those of the more posterior teeth are shorter, becoming little higher than wide anteroposteriorly.

Measurements of Ramus and Teeth.		M.
Length of symphysis		.336
Width at posterior end of symphysis		.075
Depth " " "		.037
Diameters symphysis at middle	transverse	.037
	vertical	.030
Diameters at second pair of teeth	transverse	.042
	vertical	.021

* These comparisons are rendered possible by the admirable monograph of these reptiles by M. Eudes Deslongchamps in Vol. x, Bulletin Soc. Linnéenne de Normandie, 1866.

† Quarterly Journal, Geol. Society, London, 1849, p. 383.

Measurements of Ramus and Teeth.		M.
Diameters of base of seventh tooth from end	anteroposterior	.011
	transverse	.0085
Length of crown of a loose tooth (same animal)		.0225
Diameters middle crown of a loose tooth	anteroposterior	.080
	transverse	.050

From these measurements it is evident that the anterior extremity of the lower jaw is not expanded. The teeth of the anterior pair are directed rather more anteriorly than exteriorly. At the symphysis a horizontal figure ∞-shaped fossa marks the junction of the splenial and dentary bones, and the inferior side of the former is grooved on the middle line for 15 mm. in front of the symphysis.

The malar bone is elongate and strongly compressed, showing the great obliquity of the os quadratum. It sends upwards a postorbital branch, which is external as in other Teleosauridæ, and not internal as in Crocodilidæ. The surface is marked with shallow longitudinal fossæ like those of the lower jaw. Length from postorbital branch to quadratojugal, upper edge, .120; lower edge, .165; depth at middle, .024; thickness, .010.

In the most anterior dorsal preserved, the diapophyses are entirely on the neurapophyses. The articular faces of the centrum are shallowly concave, and the sides between them are flattened but not very concave. The hypapophysis has a long compressed base, which ceases 10 mm. anterior to the posterior extremity of the centrum. The neurapophysial suture is very little decurved in the middle. The diapophysis displays a capitular articular process, with small facet, which originates just above the suture with the centrum. The tubercular facet is at the extremity of a robust process, whose posterior edge originates near the posterior edge of the neurapophysis, and is wide at the base, enclosing a fossa. A section of the base of the diapophysis is subquadrate, with the superior or anterior angle rounded, and the inferior anterior produced downwards and forwards for the base of the capitular portion, like the tail of a comma. The general form of the tubercular part of the diapophysis is subconical. A convexity proceeds from its anterior base, its continuation forming the lateral convex face of the prezygapophysis. The latter is small, and its superior or articular face is on a level with the roof of the neural arch, thus having a rather low position. The arch rises steeply to the neural spine. The latter is moderately elevated, and is much compressed and thin, having a narrow anterior edge, and a posterior edge not quite so narrow. The summit is not thickened, as is the case in *Teleosaurus cadomensis*, according to Deslongchamps, and is wide anteroposteriorly. Both anterior and posterior edges of the spine are a little thickened, and are medially grooved for a short distance above the neural canal. The neural canal is ample, and is a little wider than high at its anterior extremity.

In a dorsal vertebra near that last described in the series, the capitular part of the diapophysis is carried nearer to the tubercular portion, and the base of the two combined is less robust, the section having an elon-

gate triangular outline, the base anterior. The capitular portion is still decurved so as to present below the tubercular, and is narrow. The prezygapophyses are small. The postzygapophyses are close together, and are separated by a deep groove. The articular faces are shallowly and equally concave, and are vertical to the long axis of the centrum. The hypapophysis occupies the anterior three-quarters of the middle line of the centrum.

In a dorsal posterior to the one last described, the diapophysis is still more depressed at the base, which is oblique to the long axis by about 25°. The postzygapophyses are concave on their articular faces, the concavity extending as a shallow groove to the posterior base of the diapophysis. They are separated by a vertical groove of the base of the neural spine still deeper than in the vertebra last described. The centrum is less compressed than in those more anterior, and there is not even a keel to represent the hypapophysis. The neural spine is less elevated than in the other dorsals described, and its summit is rounded off in front, and is compressed. The dorsal which precedes this one in the series is represented by a centrum only. This has an inferior median angle representing the hypapophysis.

An anterior caudal has a diapophysis of medium length, depressed, and when viewed from above, displaying an outline of an elongate cone with truncate apex. The zygapophyses are fairly well developed, and the neural spine is large, especially anteroposteriorly. The chevron facets are large and close together. The median line of the inferior face of the centrum is concave. The articular faces of the centrum are slightly concave, and the anterior is deeper than wide.

Measurements of Vertebræ.	M.
Total elevation of No. 1	.114
Diameters of centrum posteriorly { vertical	.035
Diameters of centrum posteriorly { transverse	.039
Diameters neural canal posteriorly { vertical	.027
Diameters neural canal posteriorly { transverse	.023
From centrum to face of postzygapophysis	.031
Length centrum at base neural canal	.048
Anteroposterior width neural spine above postzygapophyses	.040
Diameters centrum dorsal No. 2 { anteroposterior	.049
Diameters centrum dorsal No. 2 { vertical (front)	.037
Diameters centrum dorsal No. 2 { transverse (front)	.038
Length diapophysis from base, below	.038
Width at postzygapophyses, inclusive	.030
Diameters of dorsal No. 4 { anteroposterior	.048
Diameters of dorsal No. 4 { vertical (behind)	.040
Diameters of dorsal No. 4 { transverse (behind)	.040
Diameters neural canal posteriorly { vertical	.015
Diameters neural canal posteriorly { transverse	.018

Measurements of Vertebræ.	M.
Elevation neural spine from canal	.054
Length diapophysis below	.038
Width at postzygapophyses	.030
Diameters of a caudal vertebra, anteroposterior	.045
Diameters of a caudal vertebra, vertical (front)	.037
Diameters of a caudal vertebra, transverse (front)	.035
Length diapophysis below	.033
Width at postzygaphyses	.023
Length of base neural spine above postzygapophyses	.030

The coracoid bone has an expanded proximal extremity, which contracts on the external side abruptly, into a slender shaft which continues to the distal end, which is but little expanded. The coracoid foramen is well within the external border, and is small. The distal end is flattened below, and has a convex margin. The shaft has an oval section. This element is much more slender than in the *Alligator mississippiensis*, and even more so than in the *Teleosaurus cadomensis*, according to Deslongchamps.

Measurements of Coracoid.	M.
Total length	.165
Long diameter of proximal end	.065
Thickness of proximal end at glenoid facet	.023
Diameter of shaft, vertical	.010
Diameter of shaft, transverse	.015
Width of distal end	.0295

The humerus is rather elongate, and is but little curved. The head is directed a little inwards and forwards, and the condyles (which are lost) a little backwards. The section of the shaft is nearly round from below the deltoid crest to near the condyles. The head is flattened and its articular extremity is convex and narrow. Near the internal border of the anterior side is a shallow fossa. The deltoid crest is elongate, and lies on the external edge of the posterior face. Its elevation increases distal, *i. e.*, to a point nearly two-fifths the length from the head.

Measurements of Humerus.	M.
Length of part preserved	.220
Diameters of head, anteroposterior	.019
Diameters of head, transverse	.051
Diameters shaft 3 c.m. below crest, anteroposterior	.025
Diameters shaft 3 c.m. below crest, transverse	.027

General Remarks.—The characters of this species are much like those of *H. rodgersi*, so far as they are known. I observe the following differences on comparison with several individuals of that species. The articular faces of the vertebral centra, are less concave than in the Northern species. The symphyseal part of the mandible is a part of a cylinder in the *H. rodgersi*, while it is flattened below and at the sides in the Brazilian

species. The bones of the limbs are relatively less robust in the *H. derbianus.** The differences, especially in the humerus, are well marked.

I name this species in honor of Prof. Orville A. Derby, in charge of the department of Geology in the Museo National of Brazil.

MAMMALIA.

TOXODON EXPANSIDENS sp. nov.

The incisors of the first and second places of the upper jaw, represent this species. Comparison with the corresponding teeth of the known species, reveals well-marked distinctive characters.

The incisor of the median pair has greater transverse, and less anteroposterior, diameter than in any of the known species. Its diameters are uniform. The cutting edge is five and a half times as long transversely as it is anteroposteriorly. The anterior enameled face has two planes, a wide exterior one which is concave, and a narrower inner one which retreats inwards, and is plane to the convex inner (median) edge. The enamel extends round the narrow external edge, but disappears at the middle of the inner beveled faces. The angle between the two faces forms a rib, parallel with the borders of the tooth. No enamel on the internal face. Enamel surface with rather coarse obsolete longitudinal grooves.

The external incisor is a robust, prismatic, rodent-like tooth, strongly curved. Its section is triangular, the posterior (enameled) face being convex. The external face is flat, and its plane forms less than a right angle with the anterior face, from which it is separated by a convex intermediate surface. The prominence of the latter causes the anterior face to be slightly concave. The angle is the most prominent portion of the cutting edge. The enamel ceases a little short of the narrow internal edge of the tooth; its surface is marked with obsolete longitudinal grooves.

Measurements of Teeth.			M.
First incisor.			
Diameters of crown	vertical		.080
	transverse		.059
	anteroposterior	at middle	.011
		at angle	.015
Width of internal level			.022
Second incisor.			
Diameters of tooth	vertical on curve		.150
	transverse		.033
	anteroposterior (externally)		.021

This species is as large as the *Toxodon platensis* Owen. As compared with that animal, the median incisors have much greater transverse extent, and relatively smaller anteroposterior diameter. These teeth are

*For figures of humerus and femur of *H. rodgersi*, see Transac. Amer. Philos. Soc. xiv, Pl. iv, figs. 10-11, 1879.

still more different from those of *T. burmeisteri*. The external incisors are, on the other hand, more like those of the latter species in their triangular form, though their inner angle is not produced as in that species.

Explanation of Plate.

The figures represent the *Stereosternum tumidum* in various pieces; all of the natural size excepting fig. 1, which is three-fourths natural size.

Fig. 1. The typical specimen on a slab of calcareous shale of the carboniferous formation; the anterior part of the skeleton wanting; viewed from below. *nc*, notochordal canal exposed by the splitting of the vertebral centrum.

Fig. 2. Vertebræ in a piece of weathered rock of darker color than the slab.

Fig. 3. A lumbar vertebra from the piece of matrix represented in fig. 2, anterior view; *a*, inferior view.

Fig. 4. A caudal vertebra from the same piece of stone, left side; *a*, inferior side.

Fig. 5. A dorsal vertebra with proximal portions of ribs embracing the centrum; from a different piece of matrix.

Fig. 6. A vertebra of uncertain position, with descending processes, anterior view; *a*, the same lateral view.

Fig. 7. Humerus, the proximal portion represented by a mould; from a separate piece.

Fig. 8. Coracoid bone from a separate piece.

All the specimens are preserved in Museo Nacional of Rio Janeiro, excepting that represented in fig. 1, which is in the collection of Madame Ribeira de Andrada.

Some new Hypotrichous Infusoria. By Dr. Alfred C. Stokes.

(*Read before the American Philosophical Society, June 19, 1885.*)

Wet Sphagnum seems to be a favorite haunt for certain fresh-water protozoa. Dr. Leidy found it an unfailing source of supply for many of the Rhizopoda, some of the most interesting forms described by that illustrious naturalist being obtained from a little bunch of the moss. In my own vicinage the beautiful plant is comparatively rare, but a single marsh of not extended dimensions does happily exist here, with the pale Sphagnum in some abundance greenly glimmering beneath the shallow water, while the shadows of elder, azalea and serviceberry, and the broad leaves of tangled smilax vines make the neighboring thicket dim and cool even when the hot sun smites the furrowed field that borders it. Among these pleasing surroundings the Rhizopoda are in numbers excelled only by the Infusoria, as the following previously undescribed forms testify. And it is

a fact worthy of note that the greater proportion of the Infusoria thus far there obtained belong to one family, the Oxytrichidæ of Ehrenberg.

With the exception of certain forms mentioned in this paper, there are but four genera included in the Oxytrichidæ without that posterior cluster of appendages named from their position the anal styles. Their presence or absence is therefore of diagnostic value. It is their absence that separates Hemicycliostyla from Urostyla, which it otherwise closely resembles, even in form and movements. Its position in the family group is evidently lower than that of Urostyla, simply because these posterior ventral appendages have not been developed.

Hemicycliostyla (*ἡμικυκλιος, semicircular; στυλος, a style*), gen. nov. Animalcules free-swimming, more or less elongate-ovate, soft, flexible and elastic, the extremities rounded; frontal styles twenty or more, arranged in two more or less semicircular rows; adoral ciliary fringe beginning near the center of the right-hand side of the peristome-field; ventral surface entirely clothed with fine setæ arranged in closely approximated longitudinal rows; anal styles absent; contractile vesicle single or double; nucleus multiple.

Hemicycliostyla sphagni, sp. nov. (Fig 1). Body elongate-ovate, soft, flexible and extensile, four times as long as broad, widest behind the center; tapering to the rounded posterior extremity and to the convex, narrower frontal extremity which is curved toward the left-hand side; frontal styles about twenty, in two semicircular rows; marginal setæ not differing from the ventral, scarcely projecting beyond the body-margin except at the posterior border; peristome-field confined to the anterior third of the ventral surface, the right-hand margin ciliate and bearing a membrane; adoral cilia short; nucleus multiple, the nodules ovate or subspherical, small, numerous and scattered; contractile vesicle double, spherical, placed near the left-hand side of the anterior body-half; anal aperture dorsal, near the posterior extremity; parenchyma vacuolar; hispid dorsal setæ small. Length of body 1-50 to 1-60 inch. Habitat.—Marsh water, with Sphagnum.

There is another form (Fig. 2) resembling this in a general way, but readily distinguishable from it, not only in shape and size, but chiefly by the presence of a single contractile vesicle, the greater abundance of the nuclear nodules, the absence of vacuolar spaces within the endoplasm, and the development of a conspicuous series of par-oral cilia on the inner edge of the left-hand border of the peristome-field. The body is also less extensile than in *H. sphagni*, and the Infusorian is somewhat less active in its movements. In both the endoplasm is usually made dark and almost opaque by the great quantity of granular matter crowding it centrally.

Hemicycliostlya trichota, sp. nov. (Fig. 2). Body elongate-ovate, somewhat extensile, about three times as long as broad, widest posteriorly, tapering to the anterior extremity, which is slightly curved toward the left-hand side; frontal styles and ventral setæ essentially as in *H. sphagni*; peristome-field confined to the anterior half of the ventral surface, a series

of par-oral cilia developed on the left-hand margin, a membrane and a præ-oral ciliary fringe on the right-hand border; nucleus multiple, the nodules small, ovate or sub-spherical, scattered throughout the entire body; contractile vesicle single, spherical, near the center of the left-hand side of the peristome-field; immotile hispid dorsal setæ very small and fine; parenchyma not vacuolar. Length of body 1-60 inch. Habitat.—Marsh water, with Sphagnum.

In *Urostyla gigas* (Fig. 3) we have the largest member of the genus and a giant among Infusoria. Its movements too are correspondingly slow, with much doubling and twisting of the body. And its appetite seems also in proportion to its size, very little that can be forced through the oral aperture coming amiss, even angular grains of sand being occasionally swept into the endoplasm.

The parenchyma is as conspicuously vacuolar as in *Hemicycliostyla sphagni*, the trabecular structure being most extensively developed at the extremities. This condition is constant, none of the numerous individuals observed being without it. In appearance it resembles the similar condition of the parenchyma in *Loxodes rostrum* Ehr. and *Trachelius ovum* Ehr., probably being nearer that of the former, inasmuch as the pseudo-cellular structure does not vary in the same individual, at least while under observation, whereas in *Trachelius ovum* changes in size, position and arrangement of the trabeculæ are frequently made under the eye of the investigator, and two individuals are seldom captured with precisely the same plan of vacuolar distribution. But with *U. gigas* from this vicinity, one arrangement seems quite general and constant. Whether this will obtain in others from a different locality is conjectural.

The nuclei are wonderfully numerous. I have found it impossible to count them with the same result twice in succession, since they are not only irregularly distributed in different planes, but because the animalcule's writhing and twisting movements make such attempts impracticable. They number, however, from forty to sixty. That they are connected by a funiculus, either in the present forms or in *Hemicycliostyla sphagni* or *H. trichota*, I have been unable to ascertain. But if a connecting thread exists, it must be very frail, since the nuclear nodules float out freely and separately from the disintegrated dead body.

Aside from these peculiarities the Infusorian can be easily recognized by the arrangement of the double row of curved vibratile setæ on the posterior extremity. They add much to the creature's attractiveness, and when quiescent are about the first part of the great Infusorian to catch the eye.

Urostyla gigas, sp. nov. (Fig. 3). Body elongate, extensile, very soft and flexible, when extended five times as long as broad, widest centrally, tapering toward both extremities, the posterior rounded and slightly curved toward the left-hand side, the anterior narrower, rounded and curved toward the right-hand side; frontal styles five or six; ventral setæ clothing the entire lower surface in closely approximated lines; anal styles six, small, slender, fimbriated, not projecting beyond the body; marginal

setæ longest and most abundantly developed about the posterior extremity, the right-hand border of which bears two oblique rows of long arcuate vibratile setæ, one series originating on the dorsal surface; peristome-field confined to the anterior one-fourth of the ventral surface, the right-hand border ciliate, and an endoral series depending centrally; contractile vesicle single, spherical, on the left-hand side of the peristome-field; nucleus multiple; anal aperture opening on the dorsal surface at some distance from the posterior extremity; parenchyma vacuolar; hispid immotile dorsal setæ short. Length of extended body 1-30 inch. Habitat.—Marsh water, with Sphagnum.

Another species of this same genus (Fig 4), resembling the preceding, yet sufficiently dissimilar to warrant the formation of a new specific title for its reception, is not uncommon in the Sphagnum. It, too, is comparatively gigantic, but the general aspect, aside from minute structural characteristics, renders it readily recognizable. The posterior portion is prolonged as a broad tail-like continuation, a feature thus far restricted to this member alone of the Urostylæ. The right-hand postero-lateral border of this part supports a single series of long arcuate setæ similar to the double row on *U. gigas*, the contractile vesicles are ten to twelve in number, and the peristomal structure is distinctive. To accurately ascertain the number of the pulsating vacuoles is almost as difficult as to count the number of nuclear nodules, but there are not less than ten nor more than twelve, their presence at once separating the Infusorian from all the species and making necessary a slight change in the generic diagnosis as it now stands. This form I have named *Urostyla caudata*.

Urostyla caudata, sp. nov. (Fig. 4). Body elongate-elliptical, soft, flexible and extensile, five times as long as broad, widest centrally, the anterior extremity rounded and curved toward the left-hand side, the posterior portion narrowed into a straight, broad tail-like prolongation; frontal styles about twenty; ventral setæ clothing the entire ventral surface in closely approximated longitudinal lines; anal styles eight to ten, long, slender, in an oblique row, usually projecting beyond the body; marginal setæ projecting posteriorly and developed on the right-hand border of the posterior extremity as a single oblique series of long arcuate setæ; peristome-field confined to the anterior third of the lower surface, the left-hand margin finely ciliate in addition to the adoral fringe, the right-hand border bearing a membrane and a præ-oral ciliary series; nucleus multiple, the nodules numerous, scattered; contractile vesicles multiple, arranged in a row along the left-hand body-margin; parenchyma vacuolar; anal aperture opening on the dorsal surface near the posterior extremity. Length of body 1-40 inch. Habitat.—Marsh water, with sphagnum.

Previously to the capture of the three forms of Holosticha here referred to, but a single fresh-water species had been recorded. The structure of these additional sweet-water members of the genus will necessitate a change in the generic description, since the peristomal membrane, the increased number of frontal styles in *H. hymenophora* and *H. similis*, and the double

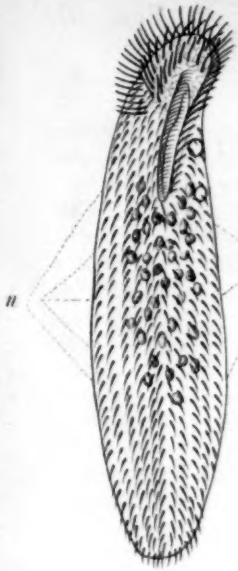


Fig. 1

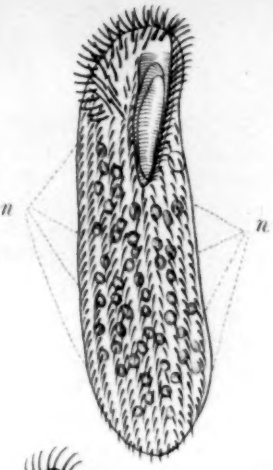


Fig. 2

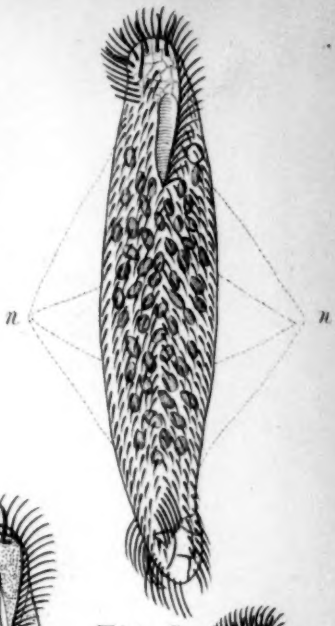


Fig. 3

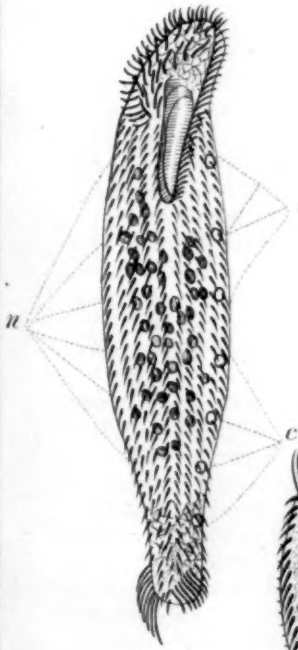


Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

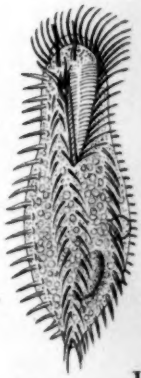


Fig. 12

Fig. 13

contractile vesicle of the former, have not been previously noticed, while a moniliform nucleus is thus far restricted to *H. similis*.

Holosticha caudata, sp. nov. (Fig. 5). Body elongate, eight times as long as broad, soft and flexible, widest centrally, constricted near the apical extremity of the peristome-field, widened anteriorly, tapering posteriorly in a tail-like prolongation, the tip somewhat dilated and curved toward the right-hand side; anterior border rounded, lip narrow, crescentic; frontal styles three; ventral setæ in two straight median rows, those on the right-hand side largest; anal styles five, slender, the extremities often fimbriated; marginal setæ numerous, large, flattened, projecting and most abundantly developed at the posterior border; peristome-field confined to the anterior one-fifth of the ventral surface, the right-hand margin finely ciliate and bearing an undulating membrane; contractile vesicle single, spherical, near the left-hand side of the apical extremity of the peristome; anal aperture dorsal near the beginning of the tail-like prolongation; immotile dorsal hispid setæ numerous, long and fine. Length of body 1-50 inch. Habitat.—Marsh water, with Sphagnum.

In *Holosticha hymenophora* (Fig. 6), a sub-terminal anal aperture exists and has been noticed several times, but whether on the ventral or dorsal surface was impossible to positively determine, as the Infusorian in each instance happened to be rapidly rotating on the long diameter, and the aperture opened and closed before the focus could be changed. My impression, however, is that it is dorsal, and I have no hesitation in predicting that the cytopyge will be observed in that position, not only among those described in this paper where the dorsal position is the rule, but with many of the Hypotricha, even with those common and seemingly best-known forms in which so important a structural point ought to have been observed long ago. An instance occurs in *Oxytricha platystoma* (Ehr.) S. K., where the writer has seen the anal aperture on the dorsal surface at the left-hand side of the median line and some distance from the posterior extremity. That it should become developed on the upper surface is certainly a satisfactory and a beautiful adaptation. The lower aspect is needed for the support of the ambulatory organs and anal styles, the posterior extremity is occupied by a luxuriant growth of marginal setæ, with usually one or more supplementary rows of similar appendages, while the dorsum is either entirely naked or only the bearer of immotile hispid hairs, which can be temporarily crowded out of position, or even permanently displaced, without inconvenience or injury to the Infusorian.

Holosticha hymenophora, sp. nov. (Fig. 6). Body elliptical, three to four times as long as broad, soft, flexible and somewhat extensile, narrowed anteriorly and slightly curved toward the left-hand side; lip prominent, crescentic; frontal styles five; ventral setæ in two straight closely approximated median rows; the left-hand series beginning at the apical extremity of the peristome; anal styles five, straight, slender, in an oblique row, the first or right-hand one slightly projecting beyond the body; marginal setæ longest and projecting posteriorly; peristome-field extending for one-third

the length of the body, the right-hand border nearly straight, finely ciliate and bearing an undulating membrane; contractile vesicle double, near the center of the left-hand body-margin; nucleus double, ovate; anal aperture sub-terminal, presumably dorsal; immotile hispid dorsal setæ short. Length of body, 1-125 to 1-150 inch. Habitat.—Shallow pools in early spring.

The form which I have named *Holosticha similis* (Fig. 7), is readily differentiated from all other species by the moniliform nucleus. Usually the nodules are arranged in a single row, but individuals occur not uncommonly with a double row, all the component nodules of each series then being in contact laterally. Here also the anal aperture is dorsal.

Holosticha similis, sp. nov. (Fig. 7). Body elongate-ovate, soft, flexible and somewhat extensile, more than four times as long as broad, the posterior extremity rounded, the anterior narrower, rounded, slightly curved toward the left-hand side; peristome-field oblique, confined to the anterior third of the lower surface, narrow, ovate, the right-hand margin ciliate; frontal styles about fourteen; ventral setæ in two straight median rows; anal styles twelve to fourteen, slender, in a long oblique row, only the most posterior ones projecting beyond the body; marginal setæ conspicuous, longest, most abundantly developed and projecting at the posterior border; contractile vesicle single, spherical, on the left-hand side of the apical termination of the peristome-field; nucleus moniliform, the nodules ovate or subspherical, in a single or double row, placed near the left-hand body-margin; anal aperture dorsal, near the posterior extremity; dorsal inmotile hispid setæ small and fine. Length of body, 1-130 inch. Habitat.—Marsh water, with Sphaghum.

The following animalcule is rather slow in its movements, especially when in contact with débris or algal filaments, then resting for a time, commonly with the dorsal surface upward, a position giving the observer an opportunity to study the numerous hispid setæ projecting from that part, but effectually concealing the more important arrangement of ventral styles and setæ. When it has reversed its position, the ventral setæ are seen to conspicuously differ in size in the two median rows, as well as in numbers. This difference is not uncommon in members of its genus (Uroleptus), but here it is unusually well marked. A similar difference also exists between the right and left-hand marginal setæ, the former being abundant and remarkably flat. This is unusual.

In many Infusoria the body is prolonged anteriorly as a narrow crescent, usually styled the upper lip. In many of these I believe this to be a continuation of the ventral plane and consequently to be in reality a lower lip. Such is the case with *Uroleptus dispar*, as shown in diagrammatic outline in figure 9.

Uroleptus dispar, sp. nov. (Figs 8 and 9). Body elongate-oblanceolate, elastic, four to five times as long as broad, widest centrally, tapering posteriorly and terminating in a narrow, flattened, tail-like prolongation; anterior region depressed; frontal border rounded, the ventral surface

prolonged anteriorly as a short, projecting crescentic lip ; peristome-field extending for about one-third the entire length of the body, the right-hand border ciliate and apparently having a narrow band-like undulating membrane ; ventral setæ in two median lines continued to the termination of the caudal prolongation, those of the right-hand series largest and most numerous ; marginal setæ large, projecting beyond the body-margin anteriorly on the right-hand side, and about the caudal extremity where they are longest and most abundantly developed, those of the right-hand body margin largest and conspicuously flattened ; frontal styles three ; contractile vesicle single, spherical, near the center of the left-hand border ; nucleus double, ovate ; dorsal aspect bearing a median and an uninterrupted marginal series of immotile hispid setæ ; anal aperture opening on the dorsal surface near the beginning of the caudal prolongation. Length of body, 1-180 to 1-150 inch. Habitat.—Fresh water.

Another member of the preceding genus, whose habitat is the Sphagnum swamp, is so distinctive in form that the diagnosis and figure (Fig. 10) are alone needed for its recognition. It is one of the most active of all the usually frisky members of the genus, darting out of the field, frequently swimming backward at the moment, so as to make its study rather difficult. It is very flexible and elastic, and at the same time one of the brightest, most graceful and beautiful of the handsome group. The extended body is delineated, in Fig. 10, as well as the absence of color, life and motion permit.

Uroleptus longicaudatus, sp. nov. Body narrowly sub-fusiform, elongate, about eight times as long as broad, extensile, widest centrally, tapering posteriorly to a long, narrow, attenuate tail-like prolongation forming one-third the length of the entire body ; anteriorly constricted into a neck-like portion, the frontal region expanded and rounded ; lip narrowly crescentic ; frontal styles three ; marginal setæ large, flattened, projecting, long est and most abundantly developed about the caudal prolongation and posterior extremity ; ventral setæ in two closely approximated median rows, one only continued through the caudal prolongation ; peristome-field confined to the anterior fifth of the lower surface, the right-hand border bearing a narrow membrane ; contractile vesicle single, spherical, near the left-hand border of the neck-like constriction ; nucleus double, ovate ; anal aperture dorsal, near the beginning of the tail-like prolongation ; hispid dorsal setæ forming several longitudinal rows. Length of extended body, 1-120 inch. Habitat.—Marsh water, with Sphagnum.

Among the Hypotrichous Infusoria canal-like contractile vesicles are comparatively rare, but a spherical pulsating vacuole with canal-like diverticula, somewhat resembling that of Stentor, has been observed only in the animalcule here referred to under the name of *Eschaneustyla brachytona*. In Spirostomum the canal-like contractile vesicle possesses an enlargement at its posterior termination ; in Stentor the single spherical vacuole gives off one branch which encircles the peristome-field, and another that extends along one lateral border, thus presenting a likeness to what obtains in this

Hypotrichous animalcule, where the pulsating channel is interrupted by two spherical vacuoles.

The proper position of the following Infusorian in a scheme of classification would probably be before the next one to be noticed, both then immediately preceding Uroleptus. From both the genera the anal styles are absent, and in Eschaneustyla the ventral setæ, which are of vital importance in generic diagnosis, exhibit an arrangement not previously observed in the family group. In form it most nearly approaches Urostyla, for which it might readily be mistaken under insufficient amplification.

Eschaneustyla (*εσχατια, the furthest part; ανευ, without; στυλος, a style*), gen. nov. Animalcules free-swimming, elliptical or ovate, not encuirassed; frontal styles numerous, more or less uncinate; ventral setæ in three unequal longitudinal lines; anal styles none; marginal setæ uninterrupted; contractile vesicle canal-like, near the left-hand border. Inhabiting fresh water.

Eschaneustyla brachytona, sp. nov. (Fig. 11). Body elongate-ovate, soft, flexible and somewhat extensile, three and one-half to four times as long as broad, both extremities usually rounded, the anterior the narrower, somewhat curved toward the left-hand side, a slight constriction beneath the frontal border; peristome-field arcuate, narrow, oblique, confined to the anterior third of the ventral surface, the posterior termination widest, deepest and curved toward the right-hand side, the right-hand border finely ciliate; frontal styles about twenty-five, in oblique lines, two or three supplementary styles forming the first row; ventral setæ in three unequal series, the right-hand row shortest, the central line longest but not extending to the posterior extremity; no anal styles; marginal setæ uninterrupted, longest and projecting at the posterior border only; contractile vesicle canal-like, extending along the entire left-hand body-margin, interrupted anteriorly by two spherical or subfusiform dilatations, one near the posterior termination of the peristome-field, the other near the center of the lateral body margin; nucleus not observed; anal aperture posteroterminal. Length of body, 1-112 to 1-150 inch. Habitat.—Standing water, with dead leaves.

The last form to be here mentioned is one apparently bridging the space between Holosticha and Uroleptus. In general appearance, in the arrangement of the ventral appendages and the conspicuously flattened marginal setæ it recalls the latter. The caudal appendage is not constant, therein differing from and separating the Infusorian from the invariably caudate Uroleptus. In this soft and variable posterior extremity it has a peculiarity not possessed by the remainder of the body, and not possessed by any member of the highly organized group to which the creature belongs. This posterior extremity is changeable in form. When first observed the part may be conspicuously bifid, soon to give place to an obtusely pointed, a truncate or an evenly rounded tip, or, as seen in a single instance and illustrated in figure 13, one point of the bifurcation may be extended in a way to suggest a pseudopodium, with a bulbous termina-

tion, the whole to be finally withdrawn into a rounded, emarginate or otherwise modified border. Consequently the Infusorian has the ability, by the extrusion of a caudal prolongation, to come very close to a Uroleptus, and by the withdrawal of the tail to return to its proper generic position.

The lamelliform marginal setæ, as they approach the posterior extremity, gradually leave the ventro-lateral border and are developed on the dorsal surface in a single row passing about the posterior part at a short distance from the margin. The utility of this arrangement it is difficult to imagine, unless it is to accommodate the anal aperture. Near the center of the dorsal aspect, in addition to the numerous, immotile hispid hairs arranged in longitudinal lines, there are developed three long flattened setæ, voluntarily vibratile and resembling those on the body-margin. Such an addition to the dorsum of an Hypotrichous Infusorian has not been previously observed. If somewhat more luxuriantly developed, these dorsal appendages might, indeed in their present condition they do, lead to interesting suggestions in respect to the affinities of the Infusorian and its order with the Heterotricha.

The large adoral cilia somewhat abruptly change their position in relation to the peristome-field as they approach the center of the left-hand border, the free extremities of those most anterior being directed toward the body-margin, while the tips of the posterior ones are vibrated above the peristome-field, the alteration at the point of transition being quite sudden. I have long suspected that this might be the arrangement in other peristomal Infusoria, but have not been previously able to demonstrate it.

In its movements the creature is erratic. Remaining for a time quietly lying with the ventral aspect upwards, suddenly with a lunge like that of a microscopic cetacean it rolls over, and exposes the dorsal surface only to almost immediately begin a series of wild and grotesque backward tumblings, varying these acrobatic performances by rapid backward swimming, occasionally throwing a backward somersault. It was the broad marginal setæ and these curious movements that suggested the name as the flat-haired animalcule that tumbles over backward.

Platytrichotus (*πλατυς, broad; τρίχωτος, haired*), gen. nov. Animalcules free-swimming, soft and flexible, more or less flask-shaped, widest and inflated posteriorly, narrowest and depressed anteriorly, the ventral surface flattened; frontal styles five, uncinate; ventral setæ in two straight median lines; anal styles none; marginal setæ broad, flat, uninterrupted; nucleus single; contractile vesicle single, near the center of the left-hand border. Inhabiting fresh water.

Platytrichotus opisthobolus, sp. nov. (Fig. 12). Body flask-shaped, less than three times as long as broad; frontal margin rounded, lip narrow, crescentic; posterior extremity soft and changeable in shape, obtusely pointed, emarginate, bifid, but usually evenly rounded; frontal styles five; ventral setæ in two median rows, increasing in length posteriorly, those

of the right-hand series largest and most numerous; marginal setæ large, lamelliform, obliquely truncate, projecting beyond the right-hand body-margin, the posterior ones continued across the posterior part of the dorsal aspect; peristome-field extending to the center of the ventral surface, the left-hand margin with a series of fine par-oral cilia, the right-hand border ciliate and bearing a membrane; contractile vesicle single, spherical, near the center of the left-hand border; nucleus single, large, ovate, in the posterior body-half; anal aperture postero-terminal; dorsal surface bearing numerous long hispid hairs in longitudinal lines and three large vibratile setæ developed anteriorly. Length of body, 1-145 inch. Habitat.—Marsh water, with Sphagnum.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

No. XXIV.

CONTRIBUTIONS TO MINERALOGY.

BY F. A. GENTH.

(*Read before the American Philosophical Society, October 2, 1885.*)

During the last two or three years numerous mineralogical observations have been made, some of which I had intended to investigate more fully, but, as I fear that the time which this would require would delay, if not altogether prevent their publication, I give in the following the more interesting:

1. Tin, and associated Minerals.

A highly interesting occurrence of native tin is that at the headwaters of several rivers in New South Wales. About a year ago Dr. Samuel B. Howell presented me with a specimen, and afterwards sent with another the following letter, giving fuller information about its occurrence:

"The washings I gave you sometime back came from Aberfoil river, "about fifteen miles from the town of Oban, N. S. Wales. There is with- "in two or three miles a very valuable diamond field, where corundum "gems are common. The specimens I now send you are from the Sam "river, which runs through the above-mentioned diamond field, twenty "miles from the other locality. These rivers are the headwaters of the "Clarence river, which empties into the South Pacific ocean. From this "locality I have detected platinum, iridosmine, tin and gold; the mineral "formation appears to be the same."

Both specimens showed the same association of minerals.

Tin.—The tin exists in the form of irregular, somewhat globular grains or aggregations of such grains; they are distinctly crystalline, from 0.1 to rarely over 1^{mm} in size. When magnified 60 diameters they appear to be of an uneven surface, showing planes which are too indistinct, however, for determining their form. They are grayish-white and of metallic lustre. It was impossible to select enough of the pure grains to determine their specific gravity or to make a quantitative analysis. A portion, treated with hydrochloric acid, dissolved readily with disengagement of hydrogen, leaving fine scales of iridosmine behind. Not a trace of any other metal but tin could be found in the solution.

Platinum.—The sample from the Aberfoil river yielded only a very minute quantity of platinum, when the portion insoluble in hydrochloric acid was treated with aqua regia, whilst that from the Sam river contained a considerable amount of this metal.

The grains of platinum are of irregular shape, mostly flattened. Aqua regia dissolves some of the grains very slowly, leaving a crystalline skeleton of very fine scales, probably of iridosmine. Other grains are hardly acted upon and are probably iridium or platin-iridium. The solution contained principally platinum, but also iridium and palladium.

Iridosmine.—The so-called iridosmine seems to be present, both as newjanskite in tin white, flat scales and as sisserskite in grayish-white or lead-colored scales. Some of the scales are indistinct hexagonal plates, but mostly have an irregular shape.

Gold.—The gold which I have observed in these washings is associated with quartz and of a deep yellow color, showing its high degree of fineness.

Copper.—The Sam river washings contain fine particles of native copper in the wire form.

Cassiterite.—I have observed this mineral more largely in the Aberfoil river sample; it is mostly in small, rounded grains, the largest about 10^{mm} in size; some are of a deep aurora red color, others are hyacinth red, reddish-brown or variegated, black, red and white; crystals could not be observed.

Corundum.—Sapphires in rounded grains, also in asteriated crystals, the largest 12^{mm} in diameter, and of a deep blue color occur most abundantly in the washings of the Aberfoil river, but also, with other varieties of corundum, in those of the Sam river.

Besides these and an abundance of quartz I have observed topaz of a yellowish-white color, orthoclase, garnet, brown tourmaline and other minerals, too small to distinguish.

2. *Joséite and Tetradymite.*

The peculiar telluride of bismuth from San José, Minas Geraes, Brazil (Dufrénoy's bornine, which afterwards was named joséite by Kenngott), was analyzed by Damour in 1845. The composition being so peculiar,

and not in accordance with the present views of chemical combination, a new analysis was very desirable.

Mr. Clarence S. Bement, who has in his magnificent cabinet a fine cleavage mass of about four inches in diameter, has kindly presented me with the material for this purpose.

The specimen received is of a dark steel-gray color and shows the most perfect lamination and cleavage. Between the laminæ could be observed a greenish and yellowish coating, which when magnified 100 diameters showed a crystalline structure. I also observed, under the microscope, a very minute quantity of yellowish-white globular aggregations. These coatings are the product of a partial oxidation of the mineral and were readily removed by dilute hydrochloric acid. They are probably montanite.

The analysis of the purified material gave results very close to those of Damour:

		Genth.		Damour.		
Te	=	14.67	—	15.93	—	15.68
Se	=	1.46	—	1.48	—	4.58
S	=	2.84	—	3.15	—	
Bi	=	81.23	—	79.15	—	78.40
		100.20		99.71		98.66

This composition cannot be expressed by a rational formula. There is also a doubt about its crystalline form, which is generally taken as hexagonal, with an eminently basal cleavage, although crystals, as far as I know, have never been found or examined.

Similar doubts exist about the form and rational composition of tetradymite, a question left open by Groth and others.

On crystals from Schubkau, in Hungary, Haidinger determined the form as rhombohedral, with perfect basal cleavage.

I am not aware that since then a crystallographic examination of this mineral has been made. These crystals are mostly dull, distorted and striated and not the best material for measurement. No other locality has furnished specimens in well defined crystals. It is very probable, however, that Haidinger's determination is correct, judging from a pseudomorph of gold after tetradymite from the Whitehall Mine, Spottsylvania county, Va., in the collection of the University of Pennsylvania, showing forms which appear to be combinations of a rhombohedron with a scalenohedron and the basal plane.

This does not exclude, however, that tetradymite may not also occur in rhombic forms and that the characteristic eminent cleavage may not be basal, but brachydiagonal, as in bismuthinite, stibnite and orpiment, which have an analogous composition.

It was Gustav Rose who first suggested that tetradymite was bismuth with a variable quantity of isomorphous tellurium, and this opinion has

been adopted by many chemists and mineralogists, although many facts do not sustain it.

Bismuth and tellurium are not strictly isomorphous. It is true that both crystallize in rhombohedra of nearly the same angles; bismuth, however, has an eminently basal and rhombohedral cleavage, while tellurium shows a very imperfect basal and no rhombohedral at all, but a very perfect cleavage parallel to the planes of an hexagonal prism.

There is also in all the tetradymites, excepting the two from Fluvanna county, Va., and from Highland, Montana, a portion of the tellurium replaced by sulphur, and, if therefore tellurium replaces bismuth, sulphur necessarily does it also.*

That tetradymite is not a native bismuth, *mixed* with an indefinite quantity of tellurium, becomes more than probable from the fact that all reliable analyses agree very closely with the formulæ of either of the two modifications, viz: $Bi_2 Te_3$ or $Bi_2 S_3 + 2 Bi_2 Te_3$; there are only the Cumberland (England) tetradymite, which, according to Rammelsberg, contains: Bi = 84.33, Te = 6.73, and S = 6.43, and the joséite, for the expression of a rational composition of which we must look for another explanation.

This seems to be very easy, if G. Rose's suggestion would be reversed, and that, instead of making tellurium (and sulphur) to replace bismuth, we make the latter substitute tellurium and sulphur.

This view is supported by numerous examples, and, if we examine the constitution of the natural sulphides, tellurides, arsenides, &c., &c., we find such substitutions very frequently; the hexagonal millerite, Ni S, becomes niccolite, NiAs, or breithauptite, NiSb; the isometric pyrite FeS_2, by substituting the greater portion of the iron by cobalt or nickel, smaltite (CoNiFe) As_3, or chloanthite (NiCoFe) As_2 or bismuth-chloanthite (NiCoFe) $(AsBi)_2$; the rhombic markasite, FeS_2, in the same manner gives: löllingite $FeAs_2$, safflorite (CoFeNi) As_2, and rammelsbergite (NiCoFe) As_2; or, if only a portion of the sulphur is replaced, we get as analogues for pyrite: cobaltite CoAsS, Ullmannite NiAsS or corynite Ni (SbAs) S, and for the rhombic marcasite wolfachite (NiFe) $(AsSSb)_2$, mispickel Fe $(AsS)_2$ and alloclasite (CoFe) (BiAs) S.

In the sulphosalts the substitution of bismuth for arsenic and antimony is still more frequent, but it suffices that in the examples given it is shown that sulphur is very often replaced by arsenic and antimony, and that bismuth, being analogous to these, can therefore replace sulphur and tellurium as well.

These views applied to tetradymite and allied minerals would lead to

*I have already repeatedly called attention to the fact that the analysis of the Virginia tetradymite, made by Coleman Fisher, in which he found 7.23 p. c. of selenium, was made with a part of the *identical* material which I have analyzed, and which contains not more than a trace of selenium. Notwithstanding these statements it seems to be impossible to eradicate this error, as I find it continually repeated in our best books on Mineralogy.

PROC. AMER. PHILOS. SOC. XXIII. 121. E. PRINTED OCTOBER 12, 1885.

the general formula: $Bi_3(TeSeSBi)_3$, and the Cumberland tetradymite (I) and the joséite (II) would be:

		I.		II.
Bi_2S_3	=	34.57	—	15.27
Bi_2Se_3	=	——	—	4.04
Bi_2Te_3	=	14.19	—	30.72
Bi_2Bi_3	=	48.84	—	50.17
		97.51		100.20

It would be interesting if a modification of bismuth of a rhombic form with brachydiagonal cleavage would be discovered, as it would throw some light upon the cause of dimorphism.

3. *Seleniferous Galenobismutite.*

H. Sjögren in 1879 gave the name galenobismutite with the formula: PbS. Bi_2S_3, to a mineral which is found massive and of a somewhat radiating structure at the Ko Mine, Nordmark, Sweden.

Mr. F. L. Garrison presented me last fall with a specimen of what was considered a selenide of bismuth, which he had received in Fahlun, Sweden, and which was said to have been found a short time ago in that celebrated mine.

The mineral has one very eminent cleavage, very similar to the brachydiagonal cleavage of bismuthinite, no other cleavage could be observed; color, lead gray, but much darker than bismuthinite; lustre eminently metallic; H = 2. Sp. gr., corrected for the pure mineral, = 7.145. Very brittle. It is associated with quartz, chalcopyrite and pyrrhotite in a rock composed of greenish-black fibrous and radiating hornblende and quartz.

Unfortunately, only a limited quantity was at my disposal, and the material for analysis could not be obtained in a perfect state of purity, but, as the admixtures were only quartz, chalcopyrite and pyrrhotite, these could be easily calculated and deducted.

They were: in analysis I, 3.96 %; in II, 4.25 %; in III, 5.11 %; in IV, 8.73%, and in V, 8.80 %. The following results were obtained:

	I.	II.	III.	IV.	V.	Mean.	Atomic ratio.	
Sulphur	= 9.71 –	not det. –	10.54 –	9.21 –	9.55 –	9.75 –	0.305	= 1.94
Selenium	= not det.	13.65 –	11.20 –	not det.		12.43 –	0.156	
Silver	= 28.23 –	28.18	– 0.28 –	0.39 –	0.32 –	0.33 –	0.002	= 1.1
Lead			– 28.27 –	27.72 –	27.69 –	27.88 –	0.135	
Bismuth	= 50.19 –	49.49	– 49.35 –	50.49 –	49.90 –	49.88 –	0.238	2.—
			99.64			100.27		

This gives the formula: $Pb(S_{\frac{2}{3}}Se_{\frac{1}{3}})$. $Bi_2(S_{\frac{2}{3}}Se_{\frac{1}{3}})_3$, giving:

Sulphur	=	10.43 %
Selenium	=	12.94 —
Lead	=	25.30 —
Bismuth	=	51.33 —
		100.00

Another specimen from the same locality, which was considered the same mineral, gave very different results:

This mineral, while it showed an eminent brachydiagonal cleavage, was much whiter, and less brittle. It had the same associations, but there appeared to be also some granular native bismuth in its immediate neighborhood. The analysis, after deducting 3 per cent of impurities, gave:

Sulphur	=	11.87 %
Selenium	=	4.25 —
Lead	=	5.36 —
Bismuth	=	74.44 —
		95.92

There is a loss of about 4 per cent, for which I cannot account, possibly selenium.

There was only a small quantity of the mineral obtainable for analysis, which would indicate that it is a mixture of probably about 20 per cent of the seleniferous galenobismutite with 63 per cent of bismuthinite and about 17 per cent of the native bismuth.

4. *Argentobismutite* (*Silberwismuthglanz*).

Prof. C. Rammelsberg described, in 1876, under the name silberwismuthglanz, a compact gray mineral from the Matilda Mine, Peru, corresponding to the formula: Ag_2S, Bi_2S_3.

Amongst the minerals which the late J. F. L. Schirmer presented me about eleven years ago, was a specimen of granular quartz penetrated by thin needle-shaped iron black crystals, about 1^{mm} in thickness and $10–25^{mm}$ in length, showing a deep longitudinal striation, apparently no cleavage, but an uneven fracture. It came from Lake City, Colorado, and was evidently a surface specimen. In vain I have endeavored since to get the same mineral again from the mines near Lake City.

I have made several rough tests and found in one about 24 per cent of silver and 55 per cent of bismuth. I have sacrificed the greater portion of my specimen, and by crushing and washing off the quartz and oxidized portion of the mineral, I obtained a small quantity for analysis, consisting of the nearly pure sulphide and quartz with ferric oxide, which latter were left undissolved by nitric acid.

The analysis gave:

			Atomic Ratio.
Silver	=	26.39 %	0.121
Lead	=	4.06 —	0.020
Bismuth	=	52.89 —	0.252
Sulphur, by difference	=	16.66 —	0.521

The lead may be an admixture of galenite, although the mineral had

not that appearance, but it is more probably replacing some of the silver, the analysis nearly agrees with the formula: (Ag_2Pb) S. Bi_2S_3.

The pure Ag_2S. Bi_2S_3 would have the composition:

Ag	=	28.27
Bi	=	54.97
S	=	16.76

5. Cosalite.

The name *rezbanyite* was given, in 1858, by R. Hermann, to a mixture of a sulphobismutite of lead, silver and copper and sulphate of lead; the unoxidized mineral was not analyzed, although he states that the interior mass of his specimen was quite fresh, and of a lead-gray color.

A sulphobismutite of the formula $2(PbAg_2)$ S. Bi_2S_3 from Cosala in the Province of Sinaloa, Mexico, was described by me in 1868 as *cosalite.*

In 1874, A. Frenzel reëxamined the rezbanyite and proved its identity with cosalite. For another mineral $4PbS.\ 5Bi_2S_3$, also found at Rezbanya, he now adopts the name rezbanyite.

In 1877 A. E. Nordenskiöld distinguished as *bjelkite* a mineral from the Bjelke Mine in Nordmark, Sweden, of which Nilson Lundström gave the formula: $FePb_2Bi_2S_5$. H. Sjögren, however, showed, in 1879, that the iron in Lundström's analysis was owing to an admixture of pyrrhotite, and that the pure mineral was identical with cosalite.

About two years ago I received, through the kindness of Mr. F. M. Shideler, of Lake City, Colorado, a mineral from the Gladiator Mine in Ouray county, Col., which contained, besides bismuth, lead and silver, a considerable quantity of copper, but gave the atomic ratio of cosalite; a similar mineral was described at the meeting of the Colorado Scientific Society of Dec. 3, 1883, by W. F. Hillebrand, as coming from the Comstock Mine, near Parrott City, La Plata Co., Col., and finally G. A. Kœnig, Proc. Am. Phil. Soc. xxii, 211, made an analysis of that which occurs associated with his alaskaite (galenobismutite) from the Alaska Mine, about six or eight miles above the Gladiator Mine.

The cosalite of the Gladiator Mine occurs associated with galenite, bismuthinite, chalcopyrite and pyrite in quartz. It forms small irregular masses more or less mixed with its associates, the largest which I have seen was not over 25^{mm} in diameter. It is compact, without any apparent crystalline structure; where it appears to be fibrous it is mixed with bismuthinite. Some portions have a fringe of crystalline galenite, surrounding the whole patch of the cosalite. The bismuthinite is present in small particles of a few millimeters in size, and frequently occupies the centre of the cosalite (one fragment of about 4^{mm} long was examined and found to be perfectly pure Bi_2S_3).

The cosalite is between lead gray and iron black, fracture uneven. For the analysis I selected material which was perfectly free from bismuthinite, galenite and chalcopyrite, but I was not able to obtain any which

was not slightly contaminated with pyrite and quartz. From the amount of iron found, the quantity of pyrite was calculated, and this and the quartz deducted from the material taken for analysis.

For comparison I have analyzed the cosalite from the Alaska Mine. This is free from pyrite, but contaminated with chalcopyrite, the amount of iron found gave that of chalcopyrite, which, together with quartz, were deducted from the material used for the analysis.

The following results were obtained after deducting in analysis I, 4.03 % quartz and chalcopyrite; in II, 20.67 % and in III, 19.66 % of pyrite and quartz:

		I. Alaska Mine.		II. Gladiator Mine.		III. Gladiator Mine.		Mean of II and III.	Atomic ratio.	
Sulphur	=	16.80	—	16.72	—	17.53	—	17.17	0.537	
Selenium	=	trace	—	——	—	——		——		
Arsenic	=	0.04	—	trace	—	trace	—	——		
Antimony	=	0.51	—	not det.	—	0.84	—	0.84	0.001	0.216
Bismuth	=	44.95	—	45.20	—	44.97	—	45.09	0.215	
Copper	=	8.00	—	5.87	—	5.80	—	5.84	0.046	0.201
Silver	=	1.44	—	5.67	—	5.82	—	5.75	0.027	
Lead	=	28.10	—	24.50	—	24.72	—	24.61	0.119	
Zinc	=	0.24	—	0.65	—	0.50	—	0.58	0.009	
		100.08		100.17				99.88		

Atomic Ratio of $(PbCu_2Ag_2) : Bi : S = 2 : 2 : 5 = 2\,(PbAg_2Cu_2)\ S.\ Bi_2S_3$.

6. *Schirmerite and Beegerite.*

Under the name *schirmerite* I described, in 1874, a mineral from the Treasury Mine, Geneva District, Park county, Col., of the formula $PbS.\ 2Ag_2S.\ 2Bi_2S_3$, which I had received about twelve years ago from Mr. Schirmer. Later, he sent me as schirmerite several specimens from the Treasury Vault Mine, Summit county, Colorado, and has furnished the latter mineral to numerous friends. He has not been able to give me another specimen of the *original schirmerite*, and I do not know that it has been preserved in any collection.

When I took up the investigation of the sulphobismutites above described, I observed that the original schirmerite, which was bright and fresh when received, had tarnished, was quite dull, and some portions almost black, while the mineral from the Treasury Vault Mine was quite fresh in appearance. As this indicated a difference in the composition, its true nature was endeavored to be established by an analysis.

That from the Treasury Vault Mine occurs in small particles and patches, the largest about 10^{mm} in size, disseminated through quartz, associated with cubical crystals of pyrite, very little chalcopyrite, and, in some of the cavities, a yellowish earthy coating, probably of bismite.

Only a very small quantity, not over 0.0312 grm., could be taken for analysis, in which the metals were determined, and the sulphur required by them calculated. It gave:

			Atomic ratio.		
Silver	= 15.40	—	0.072	=	1.5
Lead	= 50.16	—	0.242	=	5.1
Bismuth	= 19.81	—	0.095	=	2
Sulphur	= 14.59	—	0.456	=	9.7
	100.00				

This seems to indicate that the mineral from the Treasury Vault Mine agrees with the formula of *argentiferous beegerite:*

$$(Ag_2Pb)_6 . Bi_2S_3.$$

Dr. Kœnig described, in 1881, Am. Chem. Journ., ii, 379, under the name of *beegerite*, a mineral from the Baltic vein, Park county, Colorado, which, however, he found to be entirely free from silver. Lately he described another variety from the Old Lout Mine near Lake City, Colorado, containing about 10 per cent of silver. Proc. Am. Phil. Soc. xxii, 211.

7. *Tetrahedrite. Sylvanite.*

Already about eleven years ago I have received from Mr. Schirmer specimens of a variety of tetrahedrite in quartz, associated with crystallized gypsum and a yellowish waxy oxidation product containing largely oxide of antimony, which came from the Hotchkiss Mine in the San Juan District, Colorado.

Almost identical in appearance and associations in the tetrahedrite from Governor Pitkins' Mine near Lake City, of which Mr. F. M. Shideler sent me a number of specimens.

The tetrahedrite does not show any signs of crystallization, but is massive, compact, disseminated through quartz; in the cavities are small crystals of gypsum.

Iron black. Its specific gravity = 4.885.

The material for analysis was slightly contaminated with quartz which was deducted, in I, 2.46 per cent; in II, 3 per cent.

		I.		II.		Mean.
Sulphur	=	25.97	—	not det.	—	25.97
Arsenic	=	3.30	—	3.14	—	3.22
Antimony	=	25.51	—	not det.	—	25.51
Bismuth	=	0.41	—	0.32	—	0.37
Silver	=	0.51	—	0.69	—	0.60
Copper	=	37.80	—	37.56	—	37.68
Zinc	=	lost	—	7.15	—	7.15
Iron	=	0.57	—	0.77	—	0.64
Manganese	=	0.10	—		—	0.10
						101.24

The atomic ratio leads to the accepted formula :

$$4(Ag_2Cu_2ZnFe)\,S.\,(SbAsBi)_2\,S_3.$$

An exceedingly interesting association of this tetrahedrite is that of *sylvanite*. There was in the lot of samples from Governor Pitkins' Mine a small piece of quartz, showing very few specks of tetrahedrite and also the antimony oxide coating, which showed a few silver-white, bright metallic particles, 2–3^{mm} in length and less than 1^{mm} broad, with one eminent cleavage. A qualitative examination showed that, when nitric acid was added, the particles at once became black, and on boiling dissolved, leaving bright brown gold ; the filtrate gave an abundance of silver chloride on addition of hydrochloric acid, and the filtrate evaporated to dryness yielded crystalline tellurous oxide, readily soluble in ammonium hydrate and ammonium sulphide, which latter solution, on acidulation, gave a black precipitate of tellurous sulphide.

Thus the mineral is proved to be sylvanite, which, I do not believe, has ever before been observed in this part of Colorado.

8. *Polybasite.*

Occurs with argentiferous galenite and pyrite at the Terrible Lode, Clear Creek Co., Colorado.

A crystal had a spec. grav. of 6.009 and contained :

Silver	=	62.70
Copper	=	9.57
Iron	=	0.07
Arsenic	=	0.78
Antimony	=	10.18
Sulphur (by difference)	=	16.70
		100.00

9. *Arsenopyrite and Scorodite.*

A number of years ago I received, from Northern Alabama, several lumps of ore, consisting of quartz with pale grayish-green granular scorodite, showing on some of the fissures microscopic crystals of the usual form of this mineral, the pyramidal planes predominating. The scorodite results from the oxidation of arsenopyrite, a portion of which is left unaltered in the form of grayish-white, granular patches with metallic lustre. Dilute hydrochloric acid dissolved the scorodite and left the arsenopyrite with a little quartz. After deducting 3.34 per cent of the latter the analysis gave :

				Atomic ratio.	
Sulphur	=	18.32	—	0.573	1
Arsenic	=	47.10	—	0.628	1.1
Iron	=	33.84	—	0.566	1
Copper	=	0.70			
		99.96			

1 : 1 : 1 = FeSAs.

10. *Alteration of Magnesian limestone from Berks Co., Pa.*

The magnesian limestones in the neighborhood of Reading, Berks Co., Pa., at Fritz's island, and about two miles east of Fritztown, two miles south of Sinking Spring, at the Wheatfield and Ruth's Mines, frequently undergo very interesting changes.

Evidently by the infiltration of siliceous waters the magnesian limestone is decomposed and from the magnesium carbonate, deweylite and serpentine are formed, while another portion of the magnesia separates as brucite; the calcium carbonate crystallizes, both in the form of aragonite, in small acicular crystals and radiating columnar masses, and in the form of calcite, in crystals and coarse granular masses.

Some of these minerals have already been described by E. F. Smith, jointly with D. B. Brunner and J. Schoenfeld. I am indebted to Prof. Brunner and Dr. Schoenfeld for numerous specimens of these interesting occurrences.

Brucite.—At Fritz's island brucite occurs in several varieties.

a. In coatings of indistinct crystals 3–4^{mm} in diameter and crystalline masses upon a granular limestone, largely altered into serpentine. It is colorless in thin laminæ and shows the characteristic pearly lustre. There is also, on some portions of the limestone, a thin, white coating with slight silky lustre, which may be brucite; analysis *a*1.

This brucite has already been analyzed by E. F. Smith (Am. Chem. Journ., v, 281), whose analysis I give for comparison, *a* 2.

b. A second variety is found in thin seams from 4 to 15^{mm} in thickness. I could not observe any crystals but masses which are highly crystallized, eminently showing the basal cleavage, but always in curved surfaces. It has a slightly brownish-yellow tint, and on ignition becomes dark brown from the oxidation of the considerable quantity of manganous oxide which it contains. Spec. grav. = 2.382. From the analysis it will be seen that in its composition it stands between pure brucite and Igelström's manganbrucite, although not so rich in manganous oxide, the latter containing as much as 14.16 per cent.

c. The brucite from near Sinking Spring, as Dr. Smith states, occurs in thin colorless laminæ in thin seams in the limestone, but also in silky fibrous masses or even pulverulent, with but a faint silky lustre. Dr. Smith has observed the fine silky fibres, but, not having had a sufficient quantity for analysis, mistook them for hydromagnesite. The brucite is associated with deweylite, coarse grained calcite and aragonite, in dolomite.

I have analyzed a perfectly pure piece of the silky fibrous brucite, which weighed nearly one gram, *c* 1, and for comparison give E. F. Smith's analysis of the laminated mineral, *c* 2, from the same locality:

	Fritz's Island.				Sinking Spring.	
	a 1	*a* 2	*b* 1	*b* 2	*c* 1	*c* 2
Water	= 30.92	— 32.52	— 29.70	— 29.47	— 29.91	— 31.05
Carbon dioxide	= ——	— ——	— ——	— ——	— 2.42	— ——
Silica and alumina	= ——	— ——	— ——	— 0.46	— ——	— ——
Ferric oxide	= 0.82	— 0.44	— 0.30	— 0.04	— 0.75	— 1.24
Manganous oxide	= 0.63	— ——	— 4.04	— 4.66	— ——	— ——
Magnesium oxide	= 67.64	— 66.78	— 65.38	— 64.30	— 66.62	— 66.19
Calcium oxide	= ——	— ——	— ——	— ——	— 0.11	— 1.68
	100.01	— 99.74	— 99.42	— 98.93	— 99.81	— 100.16

The 2.42 per cent of carbon dioxide in analysis *c* 1 indicate the presence of 0.20 per cent of calcium carbonate, and about 4.45 per cent of magnesium carbonate or about 6 per cent of hydromagnesite, resulting from a conversion of a small quantity of brucite into these minerals—there are still, however, over 90 per cent of unaltered brucite present.

Deweylite, Aragonite, Calcite.—In the magnesian limestone occur these three minerals, more or less mixed together and associated with brucite.

The deweylite is white, yellowish-white or brownish, amorphous, sometimes in rounded grains or in stalactites or botryoidal forms, in thin plate-like masses or slabs occasionally over one inch in thickness, or in irregular coatings. These slabs are often arranged in layers of white or brownish deweylite of greater or less purity, often intimately mixed with aragonite, which sometimes separates in the form of radiating columnar masses, some of the individuals being over 50^{mm} in length. The layers often separate very easily and the surfaces of such planes of separation are covered with small brilliant crystals of aragonite.

Calcite is also present, both in small and insignificant crystals and in coarse crystalline masses.

This deweylite has been analyzed by E. F. Smith (l. c.), also by my assistant, Mr. H. F. Keller, who found a pure yellowish fragment of waxy lustre to contain :

Silicic oxide	=	39.32
Ferrous oxide	=	0.51
Calcium oxide	=	trace
Magnesium oxide	=	41.14
Water	=	18.41
		99.38

Neither the aragonite nor calcite have been analyzed.

Pseudomorph of deweylite after aragonite.—The needle-shaped crystals of aragonite and the radiating masses undergo a change and are gradually altered into brownish-yellow deweylite.

It begins with a very thin coating of colorless and brownish-yellow deweylite upon the aragonite, which gradually becomes thicker and finally changes the entire aragonite into pure deweylite.

Serpentine.—Another very important alteration of the magnesian limestone of Berks county is that into serpentine, which can be observed in all its stages, from the pure dolomite into the pure serpentine. The latter is generally of a greenish-yellow, greenish-white or yellow color, but also sometimes brownish and grayish. Aragonite and calcite are frequently associated and magnetite in fine grains is occasionally disseminated through the mass.

Several analyses of these serpentines have been made by my assistant, Mr. Harry F. Keller, who found in those of:

		Ruth's Mine.		Wheatfield Mine.
Silicic oxide	=	42.14	—	41.46
Ferrous oxide	=	2.06	—	0.99
Magnesium oxide	=	41.61	—	44.68
Calcium oxide	=	trace	—	—
Water	=	14.20	—	14.07
		100.01		101.20

M. E. Wadsworth, in his Lithological Studies, Cambridge, 1884, page 152, speaks of the serpentine of Fitztown (Fritztown), Berks Co., Pa., as a product of the alteration of *olivine, showing yet unaltered olivine.* I cannot imagine how olivine could be present in this rock and what it is which he has taken for that mineral.

The alteration of dolomite has produced, directly and indirectly, especially at Fritz's Island, a great variety of interesting minerals. Besides serpentine and deweylite, there are grossular, vesuviante in a beautiful yellow and orange-colored variety, apophyllite, chabazite, gismondite (?), thomsonite, mesolite, stilbite (at Rautenbush), datolite and others. In a subsequent paper I may give a fuller account of some of these.

11. Ilmenite from Carter's Mine, N. C. Oligoclase.

In the chrysolite rock (unnecessarily called dunite by some authors) occurs a vein which contains corundum, and some cross-fissures furnish a white plagioclase feldspar, others a peculiar variety of ilmenite.

My assistant, Mr. Harry F. Keller, has made analyses of both. The ilmenite has been found in two varieties (a) of a brownish-black color of a somewhat purplish hue, in small masses which show an indistinct crystalline structure and basal cleavage. On the margin it becomes somewhat columnar; fracture uneven. Sp. gr. = 4.67. H = 5.5; the second variety (b) occurs in rounded modules of about 1.5 to 2″ in diameter, irregular in shape, very brittle and breaking up into small fragments of about 5 to 10^{mm} in diameter, without any regular form, with subconchoidal fracture and tarnished with bluish and purplish colors. It much resembles the so-called *Schlackige Magneteisen* from Unkel on the Rhine, although the composition is quite different. Sp. gr. = 4.68. Neither variety is magnetic.

		a		b
Titanic oxide	=	52.73	52.71	52.64
Ferric oxide	=	8.08	not det.	10.07
Ferrous oxide	=	33.08	32.96	31.11
Magnesium oxide	=	5.33	not det.	5.33
Silica	=	0.14	0.16	trace
		99.36		99.15

The feldspar which is found associated shows large cleavages and is distinctly striated. It gave the composition of oligoclase:

Silicic oxide	=	62.32
Aluminum oxide	=	25.19
Calcium oxide	=	5.01
Sodium oxide	=	8.02
Potassium oxide	=	0.25
		100.79

12. Topaz from Stoneham, Maine.

I have made last fall, at the suggestion of Mr. G. F. Kunz, an analysis of the Stoneham topaz, of which he furnished me with a perfectly transparent and colorless fragment, in order to clear up the doubt then existing about its composition, on account of an analysis published by Mr. C. M. Bradbury (Chemical News, xlviii, 109), which had given very unusual results.

Although by the very elaborate investigation of F. W. Clarke and J. S. Diller (Am. Journ. Sc. [3] xxix), the main question has been settled by showing that the Stoneham topaz has the accepted composition of topaz, I may put on record the results which I have obtained:

Spec. grav.	=	3.553
SiO_2	=	32.03
Al_2O_3	=	57.18
Fl	=	18.83
		108.03
Deduct oxygen		7.92
		100.11

13. Orthoclase from French Creek, Chester Co., Pa.

A peculiar variety of orthoclase has lately been found at the iron mines of the French Creek region, of which Dr. A. E. Foote has presented me with several specimens. The crystals are columnar, very imperfect, but appear to show the planes P, M and n (Naumann); they are deeply striated and the slender crystals from 1 to 2^{mm} in thickness and about 50^{mm} in length are radiating from a centre, forming sheaf-like or club-like aggre-

gations. Some portions show the orthoclase cleavage. Color reddish-white to flesh red. Sp. grav. = 2.528. Associated with a chloritic mineral, supposed to be glauconite, and magnetite.

The analysis gave:

Loss by ignition	=	0.67
SiO_2	=	62.68
Fe_2O_3	=	0.23
Al_2O	=	20.90
CaO	=	0.15
Na_2O	=	none
K_2O	=	15.99
		100.62

14. Muscovite, pseudomorphous after Nephelite?

Dr. A. E. Foote brought last year from Wakefield, Canada, peculiar hexagonal crystals occurring there in the granular limestone, which he gave me for analysis. The form seems to be hexagonal, the angle, between two prismatic planes, measured 120°; the larger crystal 20mm broad and 18mm high shows the basal plane, but no pyramid, some of the smaller but less perfect crystals appear to have a very small pyramidal plane also.

Yellowish-white, finely crystalline, rarely some larger cleavage planes are visible, which are probably calcite; lustre pearly to slightly vitreous. H = 3.0; spec. gr. = 2.755.

The analysis gave:

CO_2	=	0.69
H_2O	=	4.25
SiO_2	=	45.90
Al_2O_3	=	36.03
Fe_2O_3	=	trace
MgO	=	0.68
CaO	=	0.92
K_2O	=	12.08
		100.55

This is muscovite slightly contaminated with calcium carbonate.

The form suggests a pseudomorph after nephelite. In the same range at Diana, N. Y., as Geo. J. Brush has shown, nephelite is found altered into gieseckite, which latter in all probability is only a more compact and less pure variety of muscovite.

15. Stilpnomelane pseudomorphs. Ankerite.

Velvety coatings of a dark olive-green color and submetallic lustre, in pseudomorphs after an unknown tabular mineral. The specific gravity, taken in alcohol, was found to be, 2.957. Powder pale olive-green.

This variety has been analyzed in 1858, by G. J. Brush (Am. Journ. Sc.

[2] xxv, 198), who showed that the so-called chalcodite of C. U. Shepard, in all probability belongs to stilpnomelane, and, if this suggestion is correct, that this mineral contains both ferrous and ferric oxides, while Rammelsberg (Mineralchemie, 1875), assumes only ferrous oxide.

From Dr. A. E. Foote, who has lately collected this mineral at the Sterling Mine near Antwerp, N. Y., I have received some very pure material, which made it desirable to reëxamine it, especially with reference to the state of the oxidation of the iron.

For the determination of the ferrous oxide, 0.3522 grm. were dissolved in dilute sulphuric acid, after the air had been driven out by carbonic dioxide; and the ferrous oxide determined by titration with potassium permanganate; the water was determined directly in a chloride of calcium tube from 0.3635 grm. and 0.9854 grm. taken for the other determinations. The analysis gave:

			Atomic ratio.			
SiO_2	=	44.75 %	0.746	=		10.2
Al_2O_3	=	4.36 —	0.042	=	0.073	= 1.
Fe_2O_3	=	4.99 —	0.031			
MnO	=	trace				
FeO	=	30.34 —	0.421	=	0.558	= 7.6
MgO	=	5.47 —	0.137			
H_2O	=	9.18 —	0.510	=		7.
			99.09			

The empirical formula: $(Fe_{\frac{3}{4}}Mg_{\frac{1}{4}})_8\ (FeAl)_2\ Si_{10}O_{31} + 6H_2O$ agrees closely with the above results.

Ankerite.—Associated with the stilpnomelane is ankerite in groups of curved rhombohedral crystals of a yellowish-white color.

The analysis gave:

$CaCO_3$	=	54.98
$MnCO_3$	=	0.78
$FeCO_3$	=	19.28
$MgCO_3$	=	24.91
		99.95

16. Calamine.

A peculiar variety of calamine, which closely resembles hydrozincite, occurs as an incrustation upon a ferruginous calamine, the principal ore, at the Bertha Mine, Pulaski county, Va.

It is earthy and cryptocrystalline and some of the incrustations had a thickness of 5mm.

I observed that after ignition it was dissolved by dilute hydrochloric acid almost instantaneously, far more readily than the hydrous mineral.

The analysis gave:

SiO_2	=	25.01
ZnO	=	67.42
H_2O	=	8.32
		100.75

17. Titanite.

Some time ago Mr. J. A. D. Stephenson, of Statesville, N. C., sent me a fragment of a crystal of titanite from the mica schist of the neighborhood, which also carries a beautiful variety of sunstone-oligoclase.

It was 15^{mm} broad, 2^{mm} thick, of a yellowish-white color, a greasy, vitreous lustre and a sp. gr. of 3.477.

The analysis gave:

SiO_2	=	29.45
TiO_2	=	38.33
Fe_2O_3	=	1.61
MnO, MgO	=	traces
CaO	=	29.11
Ignition	=	0.60
		99.10

18. Vanadinite.

The vanadinite from Wanlockhead, Scotland, occurs associated with calamine, a pale, greenish fibrous coating of pyromorphite, and rarely with minute black crystals of descloizite, in brownish-yellow barrel-shaped hexagonal prisms, generally united into globular groups, the surface of the globules often perfectly smooth and not showing a trace of the form of the crystals which produce them. They have been analyzed by A. Frenzel (Jahrb. Min., 1875, 673), but as it is very difficult to get material perfectly free from admixtures, some of his analyses do not fairly represent the composition of vanadinite. As I had some perfectly pure globules, I made an analysis which gave:

Cl	=	2.53
PbO	=	78.39
As_2O_5	=	0.34
P_2O_5	=	0.27
V_2O_5	=	18.04
		99.57

19. Annabergite.

In a previous paper, read before this Society, August 18, 1882, I mention under niccolite that an apple-green mineral is found with it at the Gem Mine, near Silver Cliff, Colorado.

It occurs as a crystalline coating or in minute somewhat globular aggregations, of a pale green to a rich apple-green color, in limestone associated with niccolite. It is frequently associated with aragonite in fine needle-shaped crystals, which often give it a superficial coating. I was able to obtain a small quantity of a state of fair purity, slightly contaminated with aragonite. After treating it in the cold with very dilute hydrochloric acid, to dissolve the aragonite, I had 0.0722 grm. for analysis, which gave:

H_2O	=	23.94
NiO	=	32.64
CoO	=	0.50
MgO	=	3.74
CaO	=	3.51
As_2O_5	=	36.64
		100.95

20. Dr. Clemens Winkler and Herderite.

Dr. Winkler published (Jahrb. Min., 1875, i, 172), a justification of his work on herderite in which he says that *my reproach that he had sacrificed valuable material by the use of incorrect methods, is unwarranted and that he must firmly repel it.*

I had intended to reply to Dr. Winkler, but really do not see any necessity for it, because, he fails to show any error in my work, but only tries to find excuses for his own shortcomings, and mentions experiments made with apatite, a mineral with which herderite has no resemblance, either physically or chemically.

That the minerals from Ehrenfriedersdorf and Stoneham are identical, *as I have suggested*, he now admits, and as this *settles* the *main question* it would be a waste of words to say more about this matter.

UNIVERSITY OF PENNSYLVANIA, August 8, 1885.

On Polysynthesis and Incorporation as Characteristics of American Languages. By Daniel G. Brinton, M. D.

(*Read before the American Philosophical Society, October 2, 1885.*)

Synopsis.

Races of mankind as co-extensive with linguistic groups.—Problems of American languages.—History of the doctrines of Polysynthesis and Incorporation.—Preliminary cautions.—Erroneous statements about aboriginal tongues.—Teachings of Duponceau.—Of Wilhelm von Humboldt.—Of Francis Lieber.—Of H. Steinthal.—Of Lucien Adam.—Of Friedrich Müller.—Of J. W. Powell.—Definitions of Polysynthesis, Incorporation and Holophrasis.—Examples of these processes.—Examinations of American tongues in which they are alleged to be absent.—(1) The Othomi and associated dialects—(2) The Bri-Bri and other Costa Rican dialects—(3) The Tupi-Guarani dialects—(4) The Mutsun.—Conclusions.

The division of the species Man into subspecies or races is not as yet a settled point in ethnology. The tendency, however, is to return to the classification proposed by Linnæus, which, in a broad way, subdivides the species with reference to the continental areas mainly inhabited by them in the earliest historic times. This is found to accord with color, and to give five subspecies or races, the White or European, the Black or African, the Yellow or Mongolian (Asiatic), the Brown or Malayan (Oceanic), and the Red or American Races.

No ethnologist nowadays will seek to establish fixed and absolute lines between these. They shade into one another in all their peculiarities, and no one has traits entirely unknown in the others. Yet, in the mass, the characteristics of each are prominent, permanent and unmistakeable; and to deny them on account of occasional exceptions is to betray an inability to estimate the relative value of scientific facts.

In the Science of Language it becomes of the highest importance to ascertain whether any such general similarity can be demonstrated between the tongues spoken by members of the same race.

On the surface, this is not apparent. Only one of the races named—the Malayan—is monoglottic. All the others seem to speak tongues with no genetic relationship, at least none indicated by etymology. The profounder study of language, however familiar to modern science, leads to a different conclusion—to one which, as cautiously expressed by a recent writer, teaches that "every large, connected terrestrial area developed only one, or scarcely more than one, fundamental linguistic type, and this with such marked individuality that rarely did any of its languages depart from the general scheme."*

This similarity is not to be looked for in likeness between words, but in the inner structural development of tongues. To ascertain and estimate such identities is a far more delicate undertaking than to compare columns of words in vocabularies; but it is proportionately more valuable.

This has yet to be done in any general way for the native tongues of America, and what I here present may be considered as merely clearing the road for some later investigator, well equipped from the arsenal of the higher linguistics.

The task—no light one—which such an investigator would have, would be, first, to ascertain what structural traits form the ground-plan or plans (if there are more than one) of the languages of the New World. Upon this ground-plan he would find very different edifices have been erected, which, nevertheless, can be classified into groups, each group marked by traits common to every member of it. These traits and groups he must carefully define. Then would come the separate question as to whether this community of traits has a genetic explanation or not. If the decision were affirmative, we might expect conclusions that would carry us much further than etymological com-

* "Diese thatsachen scheinen darauf hinzudeuten, dass jeder grössere in sich zusammenhängende ländercomplex nur einen oder doch nur ganz wenige sprachgrundtypen herausbildet, so eigenartig, dass selten eine sprache ganz aus dem allgemeinen rahmen heraustritt." Dr. Heinrich Winkler, *Uralaltaische Völker und Sprachen*, s. 147 (Berlin, 1884).

PROC. AMER. PHILOS. SOC. XXIII. 121. G. PRINTED OCTOBER 17, 1885.

parisons, and will form a truly scientific basis for the classification of American nations.

Acting merely as a pioneer to this vast scheme, I shall confine myself to the examination of two closely-related traits, said by some to be common to the ground-plan of all American tongues, while by others they are dropped from consideration altogether, or are asserted to be absent in many instances. These traits are Polysynthesis and Incorporation.

I shall first sketch the history of these linguistic doctrines; next explain their nature; and then proceed to examine in detail several groups of tongues of this continent in which they are said not to appear. If I succeed in showing that when correctly understood, one or the other, or both of them, are really present in these tongues, then I shall have taken a step towards defining the "ground-plan" which I have referred to. As I shall show that they are both expressions of the same psychological motive, if either is present in a tongue it will make for my position, and the propriety of discussing them together will be obvious.

I would note at the outset that there are a few cautions which one must observe in the search for structural peculiarities in general, and especially of these.

Thus, it will become obvious to the student of the subject that those American languages which have been lauded for their simplicity are quite sure to be those of which we know very little! The Bri-Bri, the Mutsun, Chibcha, and the Othomi, are examples. Just in proportion as our means of studying them increase, their complexity becomes apparent. The little we know about a tongue is often the safe refuge of those who claim for it an exceptional character.

There is good reason to believe that such apparent simplicity arises from the slight knowledge of the tongues possessed by the whites, to whom we are indebted for our information about them. The trading jargons are always extremely simple, and even the most complex native language readily lends itself to the formation

of a lingo as simple as "pigeon English." I have illustrated this in a recent work by a specimen of the Lenape (Algonkin) language, as in use by the settlers on the Delaware river in the seventeenth century. We know that an early missionary translated a catechism and preached sermons in this jargon. No doubt he thought he was using pure Lenape, and had that dialect shared the fate of so many others, and become extinct at an early date, we should at this day be obliged to accept Campanius' works as authentic examples of it, and should thus derive an entirely erroneous notion of its character.* I urge, therefore, that we should be extremely cautious about pronouncing on the structure of a language unless we have specimens of *native* composition—texts of *aboriginal* literature.

Even here we are not on perfectly safe ground, for there can be no doubt but that many native tongues have materially changed since their speakers have been brought more or less directly into contact with the whites.

On this point, the Rev. John Kilbuck, a very intelligent native Delaware Indian, writes me that most of his people speak Lenape only, but that they have come "to *think* like white men," and that the structure of the language is materially different from what it was formerly. This difference, as explained to me, is clearly that it is becoming more analytic, and is losing the flexibility, the power of polysynthesis, which it formerly possessed to a striking degree.

As I shall show later, Dr. Amaro Cavalcanti says the same of

*See *The Lenape and their Legends.* By D. G. Brinton, pp. 74-5. (No. v. of Brinton's "Library of Aboriginal American Literature.) The Lenape, as presented in Campanius' *Catechism*, offers no signs of incorporation, although it is really a markedly incorporative tongue; and polysynthesis does not appear, although it was on this very dialect that Duponceau chiefly founded his theories! The pretended oration by a native chief which Campanius gives in the original in his *History of New Sweden* is in this same ungrammatical jargon. His works should be a standing warning to students of American languages to be extremely solicitous about their authorities. Campanius lived seven years among the Lenape and studied their language zealously. Even Zeisberger, who lived sixty years among them, does not appear to have recognized the significance of the vowel changes in the verbs, the use of the obviatives, and such like delicate points of their syntax.

the Tupi; and the modern Maya, as it appears in the voluminous religious writings of Father Joaquin Ruz, is pronounced by so excellent a judge as Señor Pio Perez (author of the Maya Dictionary) and others to be almost a different tongue from the real spoken Maya of the natives themselves.*

The generalization that American languages constitute in certain essential structural features an independent group of tongues was first propounded in the second decade of this century by Mr. Peter Stephen Duponceau, at one time President of the American Philosophical Society, and his statements to this effect first saw the light in the publications of that society. He did not, indeed, fully analyze these features, and from this deficiency in comprehending them, was led to retract their application in certain examples (especially the Othomi) in which I shall endeavor to show they are actually present. He named, indeed, only one of them, to wit, *polysynthesis*, although it is evident that he perceived the second and equally important process, now known to linguists by the term *incorporation*.

As even quite prominent authorities have seriously misunderstood these processes, and in some instances have done grave injustice to their discoverer, I shall give an outline of their history.

Mr. Duponceau first developed his theory of the structure of American languages in his correspondence with the Rev. Mr. Heckewelder, in the summer of 1816. Referring to the forms of the Delaware verb as set forth by Zeisberger in his Grammar of that tongue, he observes: "I am inclined to believe that these

* Crescencio Carrillo writes in his *Disertacion sobre la Historia de la Lengua Maya*, sec. xvii, "El estilo del P. Ruz, como escritor maya, no ha sido de buena y general acceptacion en el país: háselo censurado por falta de claridad, y de que ha forzado mucho y de una manera extraña el giro y carácter proprio y genuino de la lengua yucateca." This was not through ignorance, for Father Ruz was thoroughly conversant with the Maya; but he wished to force it into accordance with the rules and structure of European tongues—a not uncommon tendency of missionary writers, and one quite as much to be watched for by the student of American languages as the simple ignorance of such authors as Campanius.

forms are peculiar to this part of the world, and that they do not exist in the languages of the old hemisphere." To express this peculiarity, he first employed the adjective *syntactic*, but later preferred *polysynthetic*."*

In his "Report on the General Character and Forms of American Languages," in 1819, he explained his views at greater length, and then first distinguishes, though not with desirable lucidity, between the two varieties of synthetic construction, the one (incorporation) applicable to verbal forms of expression, the other (polysynthesis) to nominal expressions. His words are—

"A *polysynthetic* or *syntactic* construction of language is that in which the greatest number of ideas are comprised in the least number of words. This is done principally in two ways. 1. By a mode of compounding locutions which is not confined to joining two words together, as in Greek, or varying the inflection or termination of a radical word as in most European languages, but by interweaving together the most significant sounds or syllables of each simple word, so as to form a compound that will awaken in the mind at once all the ideas singly expressed by the words from which they are taken. 2. By an analogous combination [of] the various parts of speech, particularly by means of the verb, so that its various forms and inflections will express not only the principal action, but the greatest possible number of the moral ideas and physical objects connected with it, and will combine itself to the greatest extent with those conceptions which are the subject of other parts of speech, and in other languages require to be expressed by separate and distinct words. Such I take to be the general character of the Indian languages."†

* *Correspondence between the Rev. John Heckewelder and Peter S. Duponceau, Esq.* Letters viii, xvi, and xxiii.

† *Report of the Corresponding Secretary to the Committee, of his progress in the Investigation committed to him of the General Character and Forms of the Languages of the American Indians.* Read 12th Jan., 1819, in the *Transactions of the Historical and Literary Committee of the American Philosophical Society.* Vol. i, 1819, pp. xxx, xxxi.

In his thesis, which received the prize of the Institute of France, in 1835, he was less explicit in his statements, defining the distinguishing trait of the American languages to be "the formation of words, not only by prefixes and suffixes, but by the intercalation, not merely of syllables, but of significant simple sounds, by which they can multiply words indefinitely."*

It should be distinctly stated on the part of Mr. Duponceau, that he at no time claimed this as a peculiarity universal to American languages. His mind was of altogether too scientific a cast to venture such a rash generalization. He guards himself repeatedly and with care against being so understood, and reiterates that his opinion must not be held to extend beyond the tongues he had studied, although he was inclined to believe that all would be found to reveal these characteristics.†

The incorporative plan—*das Einverleibungssystem*—of American languages attracted early the attention of Wilhelm von Humboldt, and in his monumental treatise, *Ueber die Verschiedenheit des menschlichen Sprachbaues und ihren Einfluss auf die geistige Entwickelung des Menschengeschlechts*, he explains, illustrates, and analyses it at considerable length. In a previous essay I have dwelt in detail on Humboldt's theory of the psychology of the incorporative system, and shall here confine myself to his objective description of it.‡

Its purpose he defines to be, "to impress the unity of the sentence on the understanding by treating it, not as a whole composed of various words, but as one word."§

A perfect type of incorporation will group all the elements of the sentence in and around the verbal, as this alone is the bond of union between the several ideas. The designation of time and manner, that is, the tense and mode signs, will include both

* *Mémoire sur le Système Grammatical des Langues de quelques Nations Indiennes de l'Amérique du Nord*, p. 247 (Paris, 1836).

† *Ibid*, pp. 67, 436.

‡ *The Philosophic Grammar of American Languages as set forth by Wilhelm von Humboldt*. By Daniel G. Brinton, pp. 24-27 (Philadelphia, 1885).

§ *Ueber die Verschiedenheit des Menschlichen Sprachbaues*, etc., s. 166.

the object and subject of the verb, thus subordinating them to the notion of action. It is "an indispensable basis" of this system that there should be a difference in the form of words when incorporated and when not. This applies in a measure to nouns and verbals, but especially to pronouns, and Humboldt names it as "the characteristic tendency" of American languages, and one directly drawn from their incorporative plan, that the personal pronouns, both subjective and objective, used in connection with the verbs, are of a different form from the independent personal pronouns, either greatly abbreviated or from wholly different roots. Outside of the verbal thus formed as the central point of the sentence, there is no syntax, no inflections, no declension of nouns or adjectives.*

Humboldt was far from saying that the incorporative system was exclusively seen in American languages, any more than that of isolation in Chinese, or flexion in Aryan speech. On the contrary, he distinctly states that every language he had examined shows traces of all three plans; but the preponderance of one plan over the other is so marked and so distinctive that they afford us the best means known for the morphological classification of languages, especially as these traits arise from psychological operations widely diverse and of no small influence on the development of the intellect.†

Dr. Francis Lieber, in an essay on "The Plan of Thought in American Languages,"‡ objected to the terms *polysynthesis* and *incorporation* that "they begin at the wrong end; for these names indicate that that which has been separated is put together, as if man began with analysis, whereas he ends with it." He therefore proposed the noun *holophrasis* with its adjective *holophras-*

* See *Ueber die Verschiedenheit*, etc., pp. 170–173, 325–6, etc.

† *Ibid*, p. 167. All references are to the edition of 1848. For a full discussion of Wilhelm von Humboldt's views on this and allied topics see the work above referred to, *The Philosophic Grammar of American Languages as set forth by Wilhelm von Humboldt; with the Translation of an unpublished Memoir by him on the American Verbs* (Philadelphia, 1885).

‡ Published in H. R. Schoolcraft's *History and Statistics of the Indian Tribes of the United States*. Vol. ii, pp. 346–349 (Washington, 1853).

tic, not as a substitute for the terms he criticized, but to express the meaning or purpose of these processes, which is, to convey the whole of a sentence or proposition in one word. Polysynthesis, he explains, indicates a purely etymological process, holophrasis "refers to the meaning of the word considered in a philosophical point of view."

If we regard incorporation and polysynthesis as structural processes of language aiming to accomplish a certain theoretical form of speech, then it will be convenient to have this word holophrasis to designate this theoretical form, which is, in short, the expression of the whole proposition in a single word.

The eminent linguist, Professor H. Steinthal, has developed the theory of incorporation more fully than any other writer. He expresses himself without reserve of the opinion that all American languages are constructed on this same plan, more or less developed.

I need not make long quotations from a work so well-known as his *Charakteristik der hauptsächlichsten Typen des Sprachbaues*, one section of which, about thirty pages in length, is devoted to a searching and admirable presentation of the characteristics of the incorporative plan as shown in American languages. But I may give with brevity, what he regards as the most striking features of this plan. These are especially three :—

1. The construction of words by a mixed system of derivation and new formation.

2. The objective relation is treated as a species of possession; and

3. The possessive relation is regarded as the leading and substantival one, and controls the form of expression.

The first of these corresponds to what I should call *polysynthesis;* the others to *incorporation* in the limited sense of the term.

Some special studies on this subject have been published by M. Lucien Adam, and he claims for them that they have refuted

and overturned the thesis of Duponceau, Humboldt, and Steinthal, to the effect that there is a process called *incorporative* or *polysynthetic* which can be traced in all American languages, and though not in all points confined to them, may fairly and profitably be taken as characteristic of them, and indicative of the psychological processes which underlie them. This opinion M. Adam speaks of as a "stereotyped phrase which is absolutely false."*

So rude an iconoclasm as this must attract our careful consideration. Let us ask what M. Adam understands by the terms *polysynthesis* and *incorporation*. To our surprise, we shall find that in two works published in the same year, he advances definitions by no means identical. Thus, in his "Examination of Sixteen American Languages," he says, "*polysynthesis* consists essentially in the affixing of subordinate personal pronouns to the noun, the postposition and the verb." In his "Study of Six Languages," he writes: "By *polysynthesis* I understand the expression in one word of the relations of cause and effect, or of subject and object."†

Certainly these two definitions are not convertible, and we are almost constrained to suspect that the writer who gives them was not clear in his own mind as to the nature of the process. At any rate, they differ widely from the plan or method set forth by Humboldt and Steinthal as characteristic of American languages. M. Adam in showing that polysynthesis in his understanding of the term is not confined to or characteristic of American tongues missed the point, and fell into an *ignoratio elenchi*.

* "Je suis donc autorisé à conclure qu'il faut tenir pour absolument fausse cette proposition devenue faute d'y avoir regardé de près, une sorte de cliché: que si les langues Américaines diffèrent entre elles par la lexique, elles possedent néanmoins en commun une seule et même grammaire." *Examen grammatical comparé de seize langues Américaines*, in the Compte-rendu of the Congrès international des Américanistes, 1877, Tome ii, p. 242. As no one ever maintained the unity of American grammar outside of the *Einverleibungssystem*, it must be to this theory only that M. Adam alludes.

† *Etudes sur Six Langues Américaines*, p. 3 (Paris, 1878); and compare his *Examen Grammatical* above quoted, p. 24, 243.

Equally narrow is his definition of incorporation. He writes, "When the object is intercalated between the subject and the verbal theme, there is *incorporation*." If this is to be understood as an explanation of the German expression, *Einverleibung*, then it has been pared down until nothing but the stem is left.

As to Dr. Lieber's suggestion of *holophrastic* as an adjective expressing the plan of thought at the basis of polysynthesis and incorporation, M. Adam summarily dismisses it as "a pedantic succedaneum" to our linguistic vocabulary.

I cannot acknowledge that the propositions so carefully worked up by Humboldt and Steinthal have been refuted by M. Adam; I must say, indeed, that the jejune significance he attaches to the incorporative process seems to me to show that he did not grasp it either as a structural motive in language, or as a wide reaching psychological process.

Professor Friedrich Müller, whose studies of American languages are among the most extended and profitable of the present time, has not given to this peculiar feature the attention which we might reasonably expect. Indeed, there appears in the standard treatise on the science of language which he is now engaged in publishing almost the same vagueness as to the nature of incorporation which I have pointed out in the writings of M. Adam. Thus, on one page he defines incorporating languages as those "which do away with the distinction between the word and the sentence;" while on another page he explains incorporation as "the including of the object within the body of the verb."* He calls it "a peculiarity of most American languages, but not of all." That the structural process of incorporation is by no means exhausted by the reception of the object within the body of the verb, even that this is not requisite to incorporation, I shall endeavor to show.

**Gründriss der Sprachwissenschaft.* Von Dr. Friedrich Müller. Compare Bd. I., s. 68, und Bd. II, s. 182.

Finally, I may close this brief review of the history of these doctrines with a reference to the fact that neither of them appears anywhere mentioned in the official "Introduction to the Study of Indian Languages" issued by the United States Bureau of Ethnology! How the author of that work, Major J. W. Powell, Director of the Bureau, could have written a treatise on the study of American languages, and have not a word to say about these doctrines, the most salient and characteristic features of the group, is to me as inexplicable as it is extraordinary. He certainly could not have supposed that Duponceau's theory was completely dead and laid to rest, for Steinthal, the most eminent philosophic linguist of the age, still teaches in Berlin, and teaches what I have already quoted from him about these traits. What is more, Major Powell does not even refer to this structural plan, nor include it in what he terms the "grammatic processes" which he explains.* This is indeed the play of "Hamlet" with the part of Hamlet omitted!

I believe that for the scientific study of language, and especially of American languages, it will be profitable to restore and clearly to differentiate the distinction between polysynthesis and incorporation, dimly perceived by Duponceau and expressed by him in the words already quoted. With these may be retained the neologism of Lieber, *holophrasis*, and the three defined as follows:

Polysynthesis is a method of word-building, applicable either to nominals or verbals, which not only employs juxtaposition with aphæresis, syncope, apocope, etc., but also words, forms of words and significant phonetic elements which have no separate existence apart from such compounds. This latter peculiarity marks it off altogether from the processes of agglutination and collocation.

Incorporation, Einverleibung, is a structural process confined

**Introduction to the Study of Indian Languages.* By J. W. Powell, p. 55, Second edition. Washington, 1880.

to verbals, by which the nominal or pronominal elements of the proposition are subordinated to the verbal elements, either in form or position; in the former case having no independent existence in the language in the form required by the verb, and in the latter case being included within the specific verbal signs of tense and mood. In a fully incorporative language the verbal exhausts the syntax of the grammar, all other parts of speech remaining in isolation and without structural connection.

Holophrasis does not refer to structural peculiarities of language, but to the psychological impulse which lies at the root of polysynthesis and incorporation. It is the same in both instances —the effort to express the whole proposition in one word. This in turn is instigated by the stronger stimulus which the imagination receives from an idea conveyed in one word rather than in many.

These words, when understood, are good enough, without inventing others. Professor Julien Vinson would like to substitute "syncopated composition" for polysynthesis.* But the process is not simply syncopated composition; and if it were, why substitute two words for one?

A few illustrations will aid in impressing these definitions on the mind.

As *polysynthetic* elements, we have the inseparable possessive pronouns which in many languages are attached to the names of the parts of the human body and to the words for near relatives; also the so-called "generic formatives," particles which are prefixed, suffixed, or inserted to indicate to what class or material objects belong; also the "numeral terminations" affixed to the ordinal numbers to indicate the nature of the objects counted; the negative, diminutive and amplificative particles which convey certain conceptions of a general character, and so on. These are

* "Le polysynthétisme, ou, pour employer une meilleure expression: la *composition syncopée*." M. Julien Vinson in the *Compte-Rendu du Congrès International des Américanistes*, 1883, p. 365.

constantly used in word-building, but are generally not words themselves, having no independent status in the language. They may be single letters, or even merely vowel-changes and consonantal substitutions; but they have well defined significance.

In *incorporation* the object may be united to the verbal theme either as a prefix, suffix or infix; or, as in Nahuatl, etc., a pronominal representative of it may be thus attached to the verb, while the object itself is placed in isolated apposition.

The subject is usually a pronoun inseparably connected, or at least included within the tense sign; to this the nominal subject stands in apposition. Both subjective and objective pronouns are apt to have a different form from either the independent personals or possessives, and this difference of form may be accepted as *a priori* evidence of the incorporative plan of structure —though there are other possible origins for it. The tense and mode signs are generally separable, and, especially in the compound tenses, are seen to apply not only to the verb itself, but to the whole scope of its action, the tense sign for instance preceding the subject.

Some further observations will set these peculiarities in a yet clearer light.

Although in polysynthesis we speak of prefixes, suffixes, and juxtaposition, we are not to understand these terms as the same as in connection with the Aryan or with the agglutinative languages. In polysynthetic tongues they are not intended to form words, but sentences; not to express an idea, but a proposition. This is a fundamental logical distinction between the two classes of languages.

With certain prefixes, as those indicating possession, the form of the word itself alters, as in Mexican, *amatl*, book, *no*, mine, but *namauh*, my book. In a similar manner suffixes or postpositions affect the form of the words to which they are added.

As the holophrastic method makes no provisions for the syntax of the sentence outside of the expression of action (*i. e.*, the

verbal and what it embraces), nouns and adjectives are not declined. The "cases" which appear in many grammars of American languages are usually indications of space or direction, or of possession, and not case-endings in the sense of Aryan grammar.

A further consequence of the same method is the absence of true relative pronouns, of copulative conjunctions, and generally of the machinery of dependent clauses. The devices to introduce subordinate propositions I have referred to in the previous essay already mentioned.

As the effort to speak in sentences rather than in words entails constant variation in these word-sentences, there arise both an enormous increase in verbal forms and a multiplication of expressions for ideas closely allied. This is the cause of the apparently endless conjugations of many such tongues, and also of the exuberance of their vocabularies in words of closely similar signification. It is an ancient error—which, however, I find repeated in the official "Introduction to the Study of Indian Languages" issued by our Bureau of Ethnology—that the primitive condition of languages is one "where few ideas are expressed by few words." On the contrary, languages structurally at the bottom of the scale have an enormous and useless excess of words. The savage tribes of the plains will call a color by three or four different words as it appears on different objects. The Eskimo has about twenty words for fishing, depending on the nature of the fish pursued. All this arises from the "holophrastic" plan of thought.

It will be seen from these explanations that the definition of Incorporation as given by M. Lucien Adam (quoted above) is entirely erroneous, and that of Professor Müller is visibly inadequate. The former reduces it to a mere matter of position or placement; the latter either does not distinguish it from polysynthesis, or limits it to only one of its several expressions.

In fact, Incorporation may take place with any one of the six

possible modifications of the grammatical formula, "subject + verb + object." It is quite indifferent to its theory which of these comes first, which last; although the most usual formula is either,

subject + object + verb, or
object + subject + verb;

the verb being understood to be the verbal theme only—not its tense and mode signs. Where either of the above arrangements occurs, we may consider it to be an indication of the incorporative tendency; but as mere position is insufficient evidence, Incorporation may be present in other arrangements of the elements of the proposition.

As a fair example of polysynthesis in nouns, we may select the word for "cross" in the Cree. The Indians render it by "praying-stick" or "holy wood," and their word for "our prayingsticks" (crosses) is:

N't'ayamihewâttikuminânak.

This is analyzed as follows:

n't', possessive pronoun, $\frac{1}{3}$ person plural.

ayami, something relating to religion.

he, indicative termination of the foregoing.

w, a connective.

âttik, suffix indicating wooden or of wood.

u, a connective.

m, sign of possession.

i, a connective.

nân, termination of $\frac{1}{3}$ person plural.

ak, termination of animate plural (the cross is spoken of as animate by a figure of speech).

Not a single one of the above elements can be employed as an independent word. They are all only the raw material to weave into and make up words.

As a characteristic specimen of incorporation we may select this Nahuatl word-sentence:

onictemacac,

I have given something to somebody;

which is analyzed as follows:

o, augment of the preterit, a tense sign.
ni, pronoun, subject, 1st person.
c, "semi-pronoun," object, 3d person.
te, "inanimate semi-pronoun," object, 3d person.
maca, theme of the verb, "to give."
c, suffix of the preterit, a tense sign.

Here it will be observed that between the tense-signs, which are logically the essential limitations of the action, are included both the agent and the near and remote objects of the action.

Or we may take the Cakchiquel

xbina camizah,

Thou wilt not kill me.

Composed of
x, sign of the future tense.
b, for *ba*, negative.
in, for *quin*, pronoun, 1st person, object.
a, pronoun, 2d person, subject.
camizah, verbal theme, "to kill."

Here the object does not come between verb and subject, but precedes the latter; but it is a true specimen of incorporation, as is proved by the prefixed tense sign.

In the modifications of meaning they undergo, American verbal themes may be divided into two great classes, either as they express these modifications (1) by suffixes to an unchanging radical, or (2) by internal changes of their radical.

The last mentioned are most characteristic of synthetic tongues. In all pure dialects of the Algonkin the vowel of the verbal root undergoes a peculiar change called "flattening" when the proposition passes from the "positive" to the "suppositive"

mood.* The same principle is strikingly illustrated in the Choctaw language, as the following example will show :†

takchi, to tie (active, definite).

takchi, to be tying (active, distinctive).

tak'chi, to *tie* (active, emphatic).

taiakchi, to tie tightly (active, intensive).

tahakchi, to keep tying (active, frequentative).

tahkchi, to tie at once (active immediate).

tullakchi, to be tied (passive definite).

tallakchi, to be the one tied (passive distinctive), etc., etc.

This example is, however, left far behind by the Qquichua of Peru, which by a series of so-called "verbal particles" affixed to the verbal theme confers an almost endless variety of modification on its verbs. Thus Anchorena in his Grammar gives the forms and shades of meaning of 675 modifications of the verb *munay*, to love.‡

These verbal particles are not other words, as adverbs, etc., qualifying the meaning of the verb and merely added to it, but have no independent existence in the language. Von Tschudi, whose admirable analysis of this interesting tongue cannot be too highly praised, explains them as "verbal roots which never reached independent development, or fragments handed down from some earlier epoch of the evolution of the language."§ They are therefore true synthetic elements in the sense of Duponceau's definition, and not at all examples of collocation or juxtaposition.

In contrast to this we may take the Maya-Quiche dialects, where there are only slight traces of these internal changes, most of the modifications being effected by affixes. Thus Francisco

*This obscure feature in Algonkin Grammar has not yet been satisfactorily explained. Compare Baraga, *Grammar of the Otchipwe Language*, p. 116 (Montreal, 1878), and A. Lacombe, *Grammaire de la Langue des Cris*, p. 155 (Montreal, 1874).

†See *Grammar of the Choctaw Languages*. By the Rev. Cyrus Byington. Edited by D. G. Brinton, pp. 35, 36 (Philadelphia, 1870).

‡ *Gramática Quechua, ó del Idioma del Imperio de los Incas.* Por el Dr. José Dionisio Anchorena, pp. 163–177 (Lima, 1874).

§ *Organismus der Khetsua-Sprache.* Von J. J. von Tschudi, p. 368 (Leipzig, 1884).

Ximenez in his *Quiche Grammar* gives twenty-four variations of the theme *bak*, bored, all by suffixes, as:*

bak, first passive.

bakatuh, second passive.

bakou, first absolute.

bakon, second absolute.

bake, first neuter.

baker, second neuter, etc., etc.

While the genius of American languages is such that they permit and many of them favor the formation of long compounds which express the whole of a sentence in one word, this is by no means necessary. Most of the examples of words of ten, twenty or more syllables are not genuine native words, but novelties manufactured by the missionaries. In ordinary intercourse such compounds are not in use, and the speech is comparatively simple.

Of two of the most synthetic languages, the Algonkin and the Nahuatl, we have express testimony from experts that they can be employed in simple or compound forms, as the speaker prefers. The Abbé Lacombe observes that in Cree "sometimes one can employ very long words to express a whole phrase, although the same ideas can be easily rendered by periphrasis."† In the syllabus of the lectures on the Nahuatl by Prof. Agustin de la Rosa of the University of Guadalaxara I note that he explains when the Nahuatl is to be employed in a synthetic, and when in an analytic form.‡

I shall now proceed to examine those American tongues which

* *Gramatica de la Lengua Quiche.* Ed. Brasseur de Bourbourg, p. 8 (Paris, 1862).

† "Ces exemples font comprendre combien quelquefois on peut rendre des mots très longs, pour exprimer toute une phrase, quoiqu' aussi on puisse facilement rendre les mêmes idées par des périphrases." Lacombe, *Grammaire de la Langue des Cris*, p. 11 (Montreal, 1874).

‡ "Se explicara la razon filosófica de los dos modos de usar las palabras en Mexicano, uno componiendo de varias palabras uno solo, y otro dejandolas separadas y enlazandolas solo por el regimen." From the programme of Prof. A. de la Rosa's course in 1870. It is greatly to be regretted that the works of this author on the Nahuatl, though recent, are so scarce as to be unobtainable.

have been authoritatively declared to be exceptions to the general rules of American grammar, as being devoid of the incorporative and polysynthetic character.

The Othomi.*

As I have said, the Othomi was the stumbling block of Mr. Duponceau and led him to abandon his theory of polysynthesis as a characteristic of American tongues. Although in his earlier writings he expressly names it as one of the illustrations supporting his theory, later in life the information he derived from Señor Emmanuel Naxera led him to regard it as an isolating and monosyllabic language, quite on a par with the Chinese. He expressed this change of view in the frankest manner, and since that time writers have spoken of the Othomi as a marked exception in structure to the general rules of synthesis in American tongues. This continues to be the case even in the latest writings, as, for instance, in the recently published *Anthropologie du Mexique*, of Dr. Hamy.†

Let us examine the grounds of this opinion.

The Othomis are an ancient and extended family who from the remotest traditional epochs occupied the central valleys and mountains of Mexico north of the Aztecs and Tezcucans. Their

*The original authorities I have consulted on the Othomi are:

Reglas de Orthographia, Diccionario, y Arte del Idioma Othomi. By Luis de Neve y Molina (Mexico, 1767).

De Linguâ Othomitorum Dissertatio. By Emmanuel Naxera (Philadelphia, 1835).

Cateiesmo en Lengua Otomi. By Francisco Perez (Mexico, 1834).

†He speaks of the Othomi in these terms:—"Une langue aux allures toutes spéciales, fondamentalement distincte de toutes les langues qui se parlent aujourd' hui sur le continent américain." *Mission Scientifique au Mexique*, Pt. i. Anthropologie, p. 32 (Paris, 1884). This is the precise opinion, strongly expressed, that it is my object to controvert. Many other writers have maintained it. Thus Count Piccolomini in the *Prolegomena* to his version of Neve's Othomi Grammar says: "La loro lingua che con nessuna altra del mondo conosciuto ha la menoma analogia, è semplice. * * * La formazione dei loro verbi, nomi ed altri derivati ha molta semplicità," etc. *Grammatica della Lingua Otomi.* p. 3 (Roma, 1841). This writer also offers an illustration of how imperfectly Duponceau's theory of polysynthesis has been understood. Not only does Piccolomini deny it for the Otomi, but he denies that it is anything more than merely running several words together with some phonetic syncopation. See the *Annotationi* at the close of his Othomi Grammar.

language, called by themselves *nhiân hiû*, the fixed or current speech* (*nhiân*, speech, *hiû*, stable, fixed), presents extraordinary phonetic difficulties on account of its nasals, gutturals and explosives. M. A. Pinart has informed me that of the many American tongues which he has studied from the lips of the natives, it is far the most difficult to catch.

It is one of a group of related dialects which may be arranged as follows:

The Othomi.
The Mazahua.
The Pame and its dialects.
The Meco or Jonaz.

It was the opinion of M. Charencey, that another member of this group was the Pirinda or Matlazinca; a position combatted by Señor Pimentel, who acknowledges some common property in words, but considers them merely borrowed.†

At the outset, it is well to express a caution about accepting without reserve Naxera's opinions on the tongue. No doubt he had practical familiarity with it in its modern and rather corrupt form, but his treatise was largely written to prove that it was not only structurally similar but lexicographically related to the Chinese:—and we all know how such a prepossession obscures the judgment. Thus, part of his object was to prove that every syllable of the polysyllabic words had an independent meaning which it always retained in the compound. It is easy to think out deceptive etymologies of this kind, especially in languages where there are many monosyllables. Thus the participle *rowing* might plausibly be compounded of the two monosyllables *row*, and *wing*, as the oarmen are seated in a row, and the blade of the oar resembles a wing.

*This is the orthography of Neve. The terminal vowels are both nasals; *nhiân* is from the radical *hiâ* to breathe, breath.

†See the "Comparacion del Othomi con el Mazahua y el Pirinda," in the *Cuadro Descriptivo y Comparativo de las Lenguas Indígenas de México*, por Francisco Pimentel. Tomo III, pp. 431–445 (Mexico, 1875).

Bayard Taylor's humorous derivation of *restaurant—res, taurus*, "bully thing"—is of similar character. That Naxera was led into this false route by his anxiety to prove the Othomi monosyllabic is evident, for example, from his treatment of the verbal terminations *tza, tze, tzi;* he makes them independent words, characterizing the imperative, and meaning to happen, to effect, and to carry; whereas Neve treats them as mere terminations, which is shown to be correct by the fact that they are retained with syncope and elision in other moods as well as in the imperative itself.* Thus

Da phāx Oghā:

Thee aid God.

Where *phāx* is an abbreviation of *phātzi.*

Naxera made the statement that the Mazahua is monosyllabic, an error in which his copyists have obediently followed him; but Pimentel pointedly contradicts this assertion and shows that it is a mistake, both for the Mazahua and for the Pame and its dialects.†

We may begin our study of the language with an examination ot the

TENSE SIGNS IN OTHOMI.

PRESENT TENSE.

1. I wish,	*di nee.*
2. Thou wishest,	*gui nee.*
3. He wishes,	*y nee.*

PAST AORIST.

1. I wished,	*da nee.*
2. Thou wished,	*ga nee.*
3. He wished,	*bi nee.*

* Compare Naxera, *Dissertatio*, p. 286, with Neve, *Reglas*, p. 149.

† See Pimentel, *Cuadro Descriptivo*, etc. Tomo III, pp. 429 and 455.

PERFECT.

1. I have wished, *xta nee.*
2. Thou hast wished, *xca nee.*
3. He has wished, *xpi nee.*

PLUPERFECT.

1. I had wished, *xta nee hma.*
2. Thou hadst wished, *xca nee hma.*
3. He had wished, *xpi nee hma.*

FIRST FUTURE.

1. I shall wish, *ga nee.*
2. Thou wilt wish, *gui nee.*
3. He will wish, *da nee.*

SECOND FUTURE.

1. I shall have wished, *gua xta nee.*
2. Thou wilt have wished, *gua xca nee.*
3. He will have wished, *gua xpi nee.*

The pronouns here employed are neither the ordinary personals nor possessives (though the Othomi admits of a possessive conjugation), but are verbal pronouns, strictly analogous to those found in various other American languages. Their radicals are:

I, *d*—.
Thou, *g*—.
He, it, *b*—.

In the present, the first and second are prefixed to what is really the simple concrete form of the verb, *y-nee.* In the past tenses the personal signs are variously united with particles denoting past time or the past, as *a*, the end, to finish, *ma* and *hma*, yesterday, and the prefix *x*, which is very noteworthy as being precisely the same in sound and use which we find in the Cakchiquel past and future tenses. It is pronounced *sh* (as in *sh*ove) and precedes the whole verbal, including subject, object,

and theme; while in the pluperfect, the second sign of past time *hma* is a suffix to the collective expression.

The future third person is given by Neve as *da*, but by Perez as *di*, which latter is apparently from the future particle *ni* given by Neve. In the second future, the distinctive particle *gua* precedes the whole verbal, thus inclosing the subject with the theme in the tense-sign, strictly according to the principles of the incorporative conjugation.

This incorporative character is still more marked in the objective conjugations, or "transitions." The object, indeed, follows the verb, but is not only incorporated with it, but in the compound tense is included within the double tense signs.

Thus, I find in Perez's Catechism,

di	*ûn-ba*	*magetzi*,
He will	give-them	heaven.

In this sentence, *di* is the personal pronoun combined with the future sign; and the verb is *ûn-nì*, to give to another, which is compounded with the personal *ba*, them, drops its final syllable, forming a true synthesis.

In the phrase,

xpi	*ûn-ba*	*hma*	*magetzi*,
he had	given-them	(had)	heaven,

both subject and object, the latter inclosed in a synthesis with the radical of the theme, the former phonetically altered and coalesced with a tense particle, are included in the double tense-sign, *x-hma*. This is as real an example of incorporation as can be found in any American language.

Ordinary synthesis of words, other than verbs, is by no means rare in Othomi. Simple juxtaposition, which Naxera states to be the rule, is not all universal. Such a statement by him leads us to suspect that he had only that elementary knowledge of the tongue which Neve refers to in a forcible passage in his *Reglas*. He writes:—"A good share of the difficulty of this tongue lies in its custom of syncope; and because the tyros who make use

of it do not syncopate it, their compositions are so rough and lacking in harmony to the ears of the natives that the latter count their talk as no better than that of horse-jockeys, as we would say."*

The extent of this syncopation is occasionally to such a degree that only a fragment of the original word is retained. As:

The charcoal-vendor, *na māthiâ*.

Here *na*, is a demonstrative particle like the Aztec *in*, and *māthiâ* is a compound of *pà*, to sell, and *thêhñâ*, charcoal.

The expression,

y mahny oqha, he loves God,

is to be analyzed,

y mâhdì nuny oqha;
he loves him God;

where we perceive not only synthesis, but the object standing in apposition to the pronoun representing it, which is incorporated with the verb.

So: *yot-gua*, light here; from *yotti*, to light, *nugua*, here.

These examples from many given in Neve's work seem to me to prove beyond cavil that the Othomi exhibits, when properly spoken, precisely the same theories of incorporation and polysynthesis as the other American languages, although undoubtedly its more monosyllabic character and the extreme complexity of its phonetics do not permit of a development of these peculiarities to the same degree as many.

Nor am I alone in this opinion. It has already been announced by my learned friend, the Count de Charencey, as the result of his comparison of this tongue with the Mazahua and Pirinda. "The Othomi," he writes, "has all the appearance of a language which was at first incorporative, and which, worn down by attri-

*"Parte de la dificultad de este idioma consiste en la syncopa, pues el no syncopar los principiantes artistas, es causa de que sus periodos y oraciones sean tan rispidos, y faltos de harmonia, por cuyo motivo los nativos los murmuran, y tienen (como vulgarmente decimos), por quartreros." *Reglas de Orthographia*, etc., p. 146.

tion and linguistic decay, has at length come to simulate a language of juxtaposition."*

Some other peculiarities of the language, though not directly bearing on the question, point in the same direction. A certain class of compound verbs are said by Neve to have a possessive declension. Thus, of the two words *puengui*, he draws, and *hiâ*, breath, is formed the verb *huehiâ*, which is conjugated by using the verb in the indefinite third person and inserting the possessives *ma*, *ni*, *na*, my, thy, his; thus,

ybuemahia, I breathe.

ybuenihia, thou breathest.

ybuenahia, he breathes.†

Literally this would be "it-is-drawing, my-breath," etc.

In the Mazahua dialects there is a remarkable change in the objective conjugations (transitions) where the whole form of the verb appears to alter. In this language *ti* = I; *ki* or *khe* = thou.

I give, *ti une*.

I give thee, *ti dakke*.

He will give us, *ti yakme*.‡

The last example is not fully explained by my authorities; but it shows the verbal change.

Something like this occurs in the Pame dialects. They reveal a manifest indifference to the integrity of the theme, characteristic of polysynthetic languages. Thus, our only authority on the Pame, Father Juan Guadalupe Soriano, gives the preterit forms of the verb "to aid:"

Ku pait, I aided.

Ki gait, thou aidedest.

Ku mait, he aided.

* "L'Othomi nous a tout l'air d'une langue primitivement incorporante, et qui, parvenu au dernier degré d'usure et délabrement, a fini par prendre les allures d'un dialecte à juxtaposition." *Melanges de Philologie et de Paléographie Américaine*. Par le Comte de Charencey, p. 80 (Paris, 1883).

† Neve, *Reglas* etc., pp. 159, 160.

‡ Pimentel, *Cuadro Descriptivo*, Tom. iii, p. 424.

So, of "to burn:"

Knu aum, I burned.

Kuddu du taum, they burned.*

A large number of such changes run through the conjugation. Pimentel calls them phonetic changes, but they are certainly, in some instances, true syntheses.

All these traits of the Othomi and its related dialects serve to place them unquestionably within the general plan of structure of American languages.

The Bri-Bri Language.

The late Mr. William M. Gabb, who was the first to furnish any satisfactory information about it and its allied dialects in Costa Rica, introduces the Bri-Bri language, spoken in the highlands of that State, by quoting the words of Alexander von Humboldt to the effect that "a multiplicity of tenses characterizes the rudest American languages." On this, Mr. Gabb comments: "This certainly does not apply to the Costa Rican family, which is equally remarkable for the simplicity of its inflections.†"

This statement, offered with such confidence, has been accepted and passed on without close examination by several usually careful linguists. Thus Professor Friedrich Müller, in his brief description of the Bri-Bri (taken exclusively from Gabb's work), inserts the observation—"The simple structure of this idiom is sufficient to contradict the theories generally received about American languages."‡ And M. Lucien Adam has lately instanced its verbs as notable examples of inflectional simplicity.§

* Pimentel, *Cuadro Descriptivo*, Tomo iii, p. 462.

† Wm. M. Gabb, *On the Indian Tribes and Languages of Costa Rica*, in the Proceedings of the American Philosophical Society for 1875, p. 532.

‡ "Dessen einfacher Bau die über die Amerikanischen Sprachen im Allgemeinen verbreiteten Theorien zu widerlegen im Stande ist." *Grundriss der Sprachwissenschaft*, ii Band, s. 318 (Wien, 1882).

§ *Le Taensa a-t-il été forgé de toutes Pièces?* Réponse à M. Daniel G. Brinton. Par Lucien Adam, p. 19 (Paris, Maisonneuve et Cie, 1885).

The study of this group of tongues becomes, therefore, of peculiar importance to my present topic.

Since Mr. Gabb published his memoir, some independent material, grammatical as well as lexicographical, has been furnished by the Rt. Rev. B. A. Thiel, Bishop of Costa Rica,* and I have obtained, in addition, several MS. vocabularies and notes on the languages prepared by Prof. P. J. J. Valentini (now of New York City) and others.

The stock is divided into three groups of related dialects, as follows :—

I. The Brunka, Bronka or Boruca, now in Southwestern Costa Rica, but believed by Gabb to have been the earliest of the stock to occupy the soil, and to have been crowded out by later arrivals.

II. The Tiribi and Terraba, principally on the head-waters of the Rio Telorio and south of the mountains.

III. The Bri-Bri and Cabecar on the head-waters of the Rio Tiliri. The Biceitas (Vizeitas) or Cachis, near the mouth of the same stream, are one of the off-shoots of the Bri-Bris; so also are the small tribes at Orosi and Tucurrique, who were removed to those localities by the Spaniards.

The Bri-Bri and Cabecar, although dialects of the same original speech, are not sufficiently alike to be mutually intelligible. The Cabecars occupied the land before the Bri-Bris, but were conquered and are now subject to them. It is probable that their dialect is more archaic.

The Bri-Bri is a language of extreme poverty, and as spoken at present is plainly corrupt. Gabb estimates the total number of words it contains as probably not exceeding fifteen hundred. Some of these, though Gabb thinks not very many, are borrowed from the Spanish; but it is significant, that among them is the pronoun "that," the Spanish *ese*.

* *Apuntes Lexicograficos de las Lenguas y Dialectos de los Indios de Costa-Rica.* Por Bernardo Augusto Thiel, Obispo de Costa-Rica (San José de Costa-Rica, 1882. Imprenta Nacional).

Let us now examine the Bri-Bri verb, said to be so singularly simple. We are at once struck by Mr. Gabb's remark (just after he has been speaking of their unparalleled simplicity) that the inflections he gives "have been verified with as much care as the difficulties of the case would admit." Evidently, then, there were difficulties. What they are become apparent when we attempt to analyze the forms of the eighteen brief paradigms which he gives.

The personal pronouns are

je, I.	*sa*, we.
be, thou.	*ha*, you.
ye, he, etc.	*ye-pa*, they.

These are both nominative and objective, personal and, with the suffix *cha*, possessives.

The tenses are usually, not always, indicated by suffixes to the theme; but these vary, and no rule is given for them, nor is it stated whether the same theme can be used with them all. Thus,

To burn, *i-norka*.	Present, *i-nyor-ket-ke*.
To cook, *i-lu'*.	" *i-luk*.
To start, *i-be-te*.	" *i-be-te*.

Here are three forms for the present, not explained. Are they three conjugations, or do they express three shades of meaning, like the three English presents? I suspect the latter, for under *ikiana*, to want, Gabb remarks that the form in-*etke*, means "he *wants* you," *i. e.*, is emphatic.

The past aorist has two terminations, one in *-na*, and one in *-e*, about the uses and meaning of which we are left equally in the dark.

The future is utterly inexplicable. Even Prof. Müller, just after his note calling attention to the "great simplicity" of the tongue, is obliged to give up this tense with the observation, "the structural laws regulating the formation of the future are still in obscurity!" Was it not somewhat premature to dwell on

the impliscity of a tongue whose simplest tenses he acknowledges himself unable to analyze?

The futures of some verbs will reveal the difficulties of this tense:—

To burn, *i-nyor-ka;*	future, *i-nyor-wane-ka.*
To cook, *i-lu';*	" *i-lu'.*
To start, *i-bete';*	" *i-bete.*
To want, *i-ki-ana;*	" *i-kie.*
To count, *ishtaung;*	" *mia shta'we.*

In the last example *mia*, is the future of the verb, *imia*, to go, and is used as an auxiliary.

The explanation I have to suggest for these varying forms is, either that they represent in fact that very "multiplicity of tense-formations" which Humboldt alluded to, and which were too subtle to be apprehended by Mr. Gabb within the time he devoted to the study of the language; or that they are in modern Bri-Bri, which I have shown is noticeably corrupted, survivals of these formations, but are now largely disregarded by the natives themselves.

Signs of the incorporative plan are not wanting in the tongue. Thus in the objective conjugation not only is the object placed between subject and verb, but the latter may undergo visible synthetic changes. Thus:

Je be sueng.

I thee see.

Ke je be wai su-na.

Not I thee (?) see-did.

In the latter sentence *na* is the sign of the past aorist, and the verb in synthesis with it drops its last syllable. The *wai* Gabb could not explain. It will be noticed that the negative precedes the whole verbal form, thus indicating that it is treated as a collective idea (holophrastically).

Prepositions always appear as suffixes to nouns, which, in com-

position, may suffer elision. This is strictly similar to the Nahuatl and other synthetic tongues.

Other examples of developed synthesis are not uncommon, as away, *imibak*, from *imia* to go, *jebak*, already.

very hot, *palina*, from *ba* + *ilinia*.

The opinion that the Bri-Bri is at present a considerably corrupted and worn-down dialect of a group of originally highly synthetic tongues is borne out by an examination of the scanty materials we have of its nearest relations.

Thus in the Terraba we find the same superfluous richness of pronominal forms which occurs in many South American tongues, one indicating that the person is sitting, another that he is standing, a third that he is walking.*

The Brunca has several distinct forms in the present tense:

I eat, *cha adeh*, and *atqui chan* (*atqui* = I).

Although Bishop Thiel supplies a number of verbal forms from this dialect, the plan of their construction is not obvious. This is seen from a comparison of the present and perfect tenses in various words. The pronouns are $\frac{1}{3}$ { *atqui*, I. / *ique*, he.

For instance:—

Brunka Verbal Forms.

To kill (radical, *aí*).
Present, I kill, *cha atqui i aíra*.
Perfect, he has killed, *iang i aíc*.

To die (radical, *cojt*).
Present, I die, *cójo drah*.
Perfect, he has died, *cojt crah*.

To hear (radical, *dój*).
Present, I hear, *aari dój ograh*.
Perfect, I have heard, *aqui dój crah*.

*Gabb, ubi suprá, p. 539.

To forget.

Present, I forget, *atqui chita uringera.*

Perfect, I have forgotten, *ochita uringea.*

These examples are sufficient to show that the Brunka conjugations are neither regular nor simple, and such is the emphatic statement of Bishop Thiel, both of it and all these allied dialects. In his introduction he states that he is not yet ready to offer a grammar of these tongues, though well supplied with lexicographical materials, and that "*their verbs are especially difficult.*"*

The Cabecar dialect, in which he gives several native funeral poems, without translations, is apparently more complicated than the Bri-Bri. The words of the songs are long and seem much syncopated.

The Tupi-Guarani Dialects.

Several writers of the highest position have asserted that these dialects, spoken over so large a portion of the territory of Brazil, are neither polysynthetic nor incorporative. Thus the late Prof. Charles F. Hartt in his "Notes on the Lingoa Geral or Modern Tupi," expressed himself:—"Unlike the North American Indian tongues, the languages of the Tupi-Guarani family are not polysynthetic in structure."† With scarcely less positiveness Professor Friedrich Müller writes:—"The objective conjugation of the Tupi-Guarani does not show the incorporation usually seen in American languages, but rather a mere collocation."‡

It is, I acknowledge, somewhat hazardous to venture an opinion contrary to such excellent authorities. But I must say, that while, no doubt, the Tupi in its structure differs widely from the

* "Especial dificultad ofrecen los verbos." *Apuntes Lexicograficos*, etc. Introd. p. iv. This expression is conclusive as to the incorrectness of the opinion of M. Adam, and Prof. Müller above quoted, and shows how easily even justly eminent linguists may fall into error about tongues of which they have limited means of knowledge. The proper course in such a case is evidently to be cautious about venturing positive assertions.

† *Transactions of the American Philological Association*, 1872, p. 58.

‡ *Grundriss der Sprachwissenschaft*, Bd. ii, p. 387.

Algonkin or Nahuatl, it yet seems to present unmistakeable signs of both an incorporative and polysynthetic character such as would be difficult to parallel outside of America.

I am encouraged to maintain this by the recent example of the erudite Dr. Amaro Cavalcanti, himself well and practically versed in the spoken Tupi of to-day, who has issued a learned treatise to prove that "the dialects spoken by the Brazilian savages present undoubtedly all the supposed characteristics of an agglutinative language, and belong to the same group as the numerous other dialects or tongues of America."* Dr. Cavalcanti does not, indeed, distinguish so clearly between agglutinative and incorporative languages, as I should wish, but the trend of his work is altogether parallel to the arguments I am about to advance.

Fortunately, we do not suffer from a lack of materials to study the Tupi, ancient and modern. There are plenty of dictionaries, grammars and texts in it, and even an "Ollendorff's Method," for those who prefer that intellectual (!) system. †

All recent writers agree that the modern Tupi has been materially changed by long contact with the whites. The traders and missionaries have exerted a disintegrating effect on its ancient forms, and often directly in the line of erasing their peculiarities, to some of which I shall have occasion to refer.

Turning our attention first to its synthetic character, one can-

* *The Brazilian Language and its Agglutination.* By Amaro Cavalcanti, LL.B., etc., p. 5 (Rio Janeiro, 1883).

† The most valuable for linguistic researches are the following:

Arte de Grammatica da Lingua mais usada na Costa do Brazil. By Joseph de Anchieta. This is the oldest authority, Anchieta having commenced as missionary to the Tupis in 1556.

Arte, Vocabulario y Tesoro de la Lengua Guarani, ó mas bien Tupi. By Antonio Ruiz de Montoya. An admirable work representing the southern Tupi as it was in the first half of the seventeenth century.

Both the above have been republished in recent years. Of modern writings I would particularly name:

Apontamentos sobre o Abañeênga tambem chamado Guarani ou Tupi. By Dr. B. C. D'A. Nogueira (Rio Janeiro, 1876).

O Selvagem i Curso da Lingua Geral. By Dr. Couto de Magalhaes (Rio de Janeiro, 1876).

not but be surprised after reading Prof. Hartt's opinion above quoted to find him a few pages later introducing us to the following example of "word building of a more than usually polysynthetic character." *

akáyu, head; *ayú*, bad.

akayayú, crazy.

muakayayu, to seduce (make crazy).

xayumuakayayú, I make myself crazy, etc.

Such examples, however, are not rare, as may be seen by turning over the leaves of Montoya's *Tesoro de la Lengua Guarani*. The most noticeable and most *American* peculiarity of such compounds is that they are not collocations of words, as are the agglutinative compounds of the Ural-Altaic tongues, but of particles and phonetic elements which have no separate life in the language.

Father Montoya calls especial attention to this in the first words of his *Advertencia* to his *Tesoro*. He says:—"The foundation of this language consists of particles which frequently have no meaning if taken alone; but when compounded with the whole or parts of others (for they cut them up a great deal in composition) they form significant expressions; for this reason there are no independent verbs in the language, as they are built up of these particles with nouns or pronouns. Thus *ñemboé* is composed of the three particles *ñe*, *mo*, *e*. The *ñe* is reciprocal; *mo* an active particle; *e* indicates skill; and the whole means 'to exercise oneself,' which we translate, 'to learn,' or 'to teach,' indeterminately; but with the personal sign added, *anemboe*, 'I learn'."

This analysis, which Montoya carries much further, reminds us forcibly of the extraordinarily acute analysis of the Cree (Algonkin) by Mr. James Howse.† Undoubtedly the two

* *Notes on the Lingoa Geral*, as above, p. 71.

† James Howse, *A Grammar of the Cree Language* (London, 1844). A remarkable production which has never received the attention from linguists which it merits.

tongues have been built up from significant particles (not words) in the same manner.

Some of these particles convey a peculiar turn to the whole sentence, difficult to express in our tongues. Thus the element *é* attached to the last syllable of a compound gives an oppositive sense to the whole expression; for example, *ajur*, "I come" simply; but if the question follows: "Who ordered you to come?" the answer might be, *ajuré*, "I come of my own accord; nobody ordered me."*

Cavalcanti observes that many of these formative elements which existed in the old Tupi have now fallen out of use.† This is one of several evidences of a change in structure in the language, a loss of its more pliable and creative powers.

This synthesis is also displayed in the Tupi, as in the Cree, by the inseparable union of certain nouns with pronouns. The latter are constantly united with terms of consanguinity and generally with those of members of the body, the form of the noun undergoing material modifications. Thus:

tete, body; *cete*, his body; *xerete*, my body.

tuba, father; *oguba*, his father; *xerub*, my father.

mymbaba, domestic animal; *gueymba*, his domestic animal.

tera, name; *guera*, his name.

Postpositions are in a similar manner sometimes merged into the nouns or pronouns which they limit. Thus: *tenonde*, before; *guenonde*, before him.

It appears to me that the substratum, the structural theory, of such a tongue is decidedly polysynthetic and not agglutinative, still less analytic.

Let us now inquire whether there are any signs of the incorporative process in Tupi.

We are at once struck with the peculiarity that there are two special sets of pronouns used with verbals, one set subjective

* Anchieta, *Arte de Grammatica*, etc., p. 75.

† *The Brazilian Language*, etc., pp. 48-9.

and the other objective, several of which *cannot be employed in any other construction.** This is almost diagnostic of the holophrastic method of speech. The pronouns in such cases are evidently regarded by the language-faculty as subordinate accessories to the verbal, and whether they are phonetically merged in it or not is a secondary question.

The Tupi pronouns (confining myself to the singular number for the sake of brevity) are as follows:

Independent personals.	Possessives.	Verbal affixes.	
		Subject.	Object.
ixe or *xe*.	*se* or *xe*.	*a*.	*xe*.
inde or *ne*.	*ne* or *re*.	*re*, *yepe*.	*oro*.
ae or *o*.	*ae* or *i*.	*o*.	*ae* or *i*.

The verbal affixes are united to the theme with various phonetic changes and so intimately as to form one word. The grammars give such examples as:—

areco, I hold; *guereco*, they hold him.
ahenoi, I call; *xerenoi*, they call me.
ayaca, I dispute him; *oroaca*, I dispute thee.

In the first person, singular, the two pronominal forms *xe* and *a* are usually merged in the synthesis *xa*; as, *xamehen*, I love.

Another feature pointing to the incorporative plan is the location of the object. The rule in the old language was to place the object in all instances *before* the verb, that is, between the verb and its subject when the latter was other than a personal suffix. Dr. Cavalcanti says that this is now in a measure changed, so that when the object is of the third person it is placed after the verb, although in the first and second persons the old rule still holds good.† Thus the ancient Tupis would say:

boia aè o-sou,
snake him he-bites.

* See Anchieta, *Arte de Grammatica*, etc., p. 52.
† *The Brazilian Language*, etc., p. 114.

But in the modern tongue it is:

boia o-sou aè.
snake he-bites him.

With the other persons the rule is still for the object to precede and to be attached to the theme:

xeoroinca, I thee kill.
xepeinca, I you kill.
xeincayepe, me killest thou.

Many highly complex verbal forms seem to me to illustrate a close incorporative tendency. Let us analyze for instance the word,

xeremimboe,

which means "him whom I teach" or "that which I teach." Its theme is the verbal *mboe*, which in the extract I have above made from Montoya is shown to be a synthesis of the three elementary particles *ñe*, *mo*, and *e*; *xe* is the possessive form of the personal pronoun, "my"; it is followed by the participial expression *temi* or *tembi*, which, according to Montoya, is equivalent to "illud quod facio;" its terminal vowel is syncopated with the relative *y* or *i*, "him, it"; so the separate parts of the expression are:—

$$xe + tembi + y + ñe + mo + e.$$

I will not pursue the examination of the Tupi further. It were, of course, easy to multiply examples. But I am willing to leave the case as it stands, and to ask linguists whether, in view of the above, it was not a premature judgment that pronounced it a tongue neither polysynthetic nor incorporative.

The Mutsun.

This is also one of the languages which has been announced as "neither polysynthetic nor incorporative," and the construction of its verb as "simple to the last degree."*

* "Kein polysynthesis und keine incorporation," says Dr. Heinrich Winkler (*Uralaltaische Völker und Sprachen*, p. 149), who apparently has obtained all his knowledge of it from the two pages devoted to it by Professor Friedrich Müller, who introduces it as "äusserst einfach." *Grundriss der Sprachwissenschaft*, Bd. ii, p. 257.

We know the tongue only through the Grammar and Phrase-Book of Father de la Cuesta, who acknowledges himself to be very imperfectly acquainted with it.* With its associated dialects, it was spoken near the site of the present city of San Francisco, California.

Looking first at the verb, its "extreme simplicity" is not so apparent as the statements about it would lead us to expect.

In the first place, the naked verbal theme undergoes a variety of changes by insertion and suffixes, like those of the Quiche and Qquechua, which modify its meaning. Thus:

Ara, to give.
Arsa, to give to many, or to give much.
Arapu, to give to oneself.
Arasi, to order to give, etc., etc.

Again:

Oio, to catch.
Oiñi, to come to catch.
Oimu, to catch another, etc.

The author enumerates thirty-one forms thus derived from each verb, some conjugated like it, some irregularly. With regard to tenses, he gives eight preterits and four futures; and it cannot be said that they are formed simply by adding adverbs of time, as the theme itself takes a different form in several of them, *aran*, *aras*, *aragts*, etc. In the reflexive conjugation the pronoun follows the verb and is united with it: As,

aragneca, I give myself,

where *ca* is a suffixed form of *can*, I; *ne*, represents *nenissia*, oneself; the *g*, is apparently a connective; and the theme is *ara*. This is quite in the order of the polysynthetic theory and is also incorporative.

Such syntheses are prominent in imperative forms. Thus from the above-mentioned verb, *oio*, to catch, we have,

oiomilyuts, gather thou for me,

* *Grammatica Mutsun;* Por el R. P. F. F. Arroyo de la Cuesta; and *Vocabulario Mutsun*, by the same, both in Shea's "Library of American Linguistics."

in which *mit* is apparently the second person *men*, with a post-position *tsa*, *mintsa;* while *yuts* is a verbal fragment from *yuyuts*, which the author explains to mean "to set about," or "to get done." This imperative, therefore, is a verbal noun in synthesis with an interjection, "get done with thy gathering." It is a marked case of polysynthesis. A number of such are found in the Mutsun phrases given, as:

Rugemitithsyuts cannis, Give me arrows.

In this compound *cannis*, is for *can* + *huas*, me + for; *yuts* is the imperative interjection for *yuyuts;* the remainder of the word is not clear. The phrase is given elsewhere

Rugemitit, Give (thou) me arrows.

Without going further into this language, of which we know so little, it will be evident that it is very far from simple, and that it is certainly highly synthetic in various features.

Conclusions.

The conclusions to which the above study leads may be briefly summarized as follows:

1. The structural processes of Incorporation and Polysynthesis are much more influential elements in the morphology of language than has been conceded by some recent writers.

2. They are clearly apparent in a number of American languages where their presence has been heretofore denied.

3. Although so long as we are without the means of examining all American tongues, it will be premature to assert that these processes prevail in all, nevertheless it is safe to say that their absence has not been demonstrated in any of which we have sufficient and authentic material on which to base a decision.

4. The opinion of Duponceau and Humboldt, therefore, that these processes belong to the ground-plan of American languages, and are their leading characteristics, must be regarded as still uncontroverted in any instance.

Aus Bosnien und der Hercegovina. By Dr. Friedrich S. Krauss.

Read before the American Philosophical Society, Oct. 2, 1885.

Die Ethnographie als die Wissenschaft von der geistigen Entwicklung und dem geistigen Wachsthum und Reifen der Völker in Bezug auf ihre innersten gesellschaftlichen Einrichtungen, Sitten, Gebräuche, Volksglauben und was drum und dran sich knüpft, diese Wissenschaft ist in diesem Sinne und Umfange neu, wenn auch noch nicht modern.

Wohl hat es seit Herodot bis auf die Gegenwart eine Unzahl Reisender gegeben, die fremde Länder und Völker besuchten und über dieselben berichteten. Die s. g. Reisebeschreibungen mögen zuweilen recht werthvolle Angaben darbieten, doch unsere neue Wissenschaft kann sich damit nun und nimmer begnügen. Dank den ausgezeichneten Verkehrsmitteln der Gegenwart sind Völker und Länder auf früher unerhörte Weise einander nahe gerückt. Für den Ethnographen gibt es keine Wunder und keine Fremde mehr. Die Wissenschaft der Ethnographie spürt den seelischen Erscheinungen des Völkerlebens überall nach, trachtet ihre Wesenheiten aufs Genaueste festzustellen und ihnen auf den Grund zu kommen.

Es ist gewiss schon Namhaftes auf diesem Gebiete geleistet worden, namentlich hat der deutsche Forscher auch hier wie sonst in den Geschäften der geistigen Arbeit Bahnbrechendes geschaffen. Thatsächlich sind uns nun Völker aufs Eingehendste bekannt von den nördlichen *Čhučken* bis zu den *Patagoniern* auf der äussersten Südspitze Amerikas, über die man noch vor fünfzig Jahren nur sagenhafte Nachrichten besass. Leider bewährte sich auch hier die alte Bemerkung, dass weite Fremde mehr zur Betrachtung und Beobachtung reise als die Heimat. Das ist leicht begreiflich, denn das Fernliegende, Verschwommene, das undeutlich Ausgesprochene entzündet die Phantasie und spornt mehr an als das Naheliegende, das Einheimische.

Daraus erklärt sich die bedauerliche Thatsache, dass uns manche kleine Völkerschaften, die mit unserer Völkersippe in keiner Weise in Berührung stehen, fast bekannter sind als unsere nächsten Nachbaren, unsere uns durch gemeinsame Abstammung, Sprache, Sitte und Brauch enge verwandten Südslaven.

Sie werden sich verwundert fragen: „Wäre es denn möglich, dass die Südslaven nichts dazu gethan hätten, dass man über ihr Volksthum ausreichenden Bescheid von ihnen selbst erhielte?“ Diese Frage ist ebenso berechtigt als der Vorwurf den einige südslavische Schriftsteller gegen mich erhoben: ‚Aber das sind ja lauter altbekannte Dinge, über welche mancher Bauer mehr weiss als Du!‘

Freilich, gewisse Erscheinungen, der Gegenwart zum Mindesten, sind denjenigen zum Theil wohl bekannt, die an jenen Sitten und Gebräuchen festhalten, gerade so wie der Bauer die Pflanzen seiner Fluren, die Kräutlerin ihre Heilwurzeln kennt. Ist aber deshalb der Bauer, der die Frucht

säet und einheimst, ist die Kräutlerin bei allen ihren getrockneten Kräuterbüscheln ein Botaniker?

Die Südslaven können sich wohl einiger ausgezeichneten Sammlungen von Volksliedern, Sagen, Märchen, Sprüchwörtern und auch zweier grosser Sammelwerke über Sitten und Gebräuche berühmen. Zu einer eigentlich wissenschaftlichen Verarbeitung dieses Stoffes finden sich bei ihnen nicht viel mehr als wenige Anläufe.

Ein wüstes, brachliegendes Gebiet eröffnet sich hier dem Forscher. Die anthropologische Gesellschaft in Wien nahm sich der Sache zuerst an, um die Wissenschaft der südslavischen Ethnographie allzeitig zu hegen und zu pflegen.

Von der Gesellschaft ermuntert, publizirte ich in ihren Mittheilungen zwei grössere Abhandlungen über südslavische *Pest- und Hexensagen*, und bald darauf wieder im Auftrage der Gesellschaft, auf Grundlage zahlreicher gedruckter und ungedruckter heimischer Quellen, mein grosses Werk *Sitte und Brauch der Südslaven*. Durch die Veröffentlichung eines ethnographischen Fragebogens über die Südslaven—der Bogen enthält an tausend Fragen—hat sich die Gesellschaft ein besonderes Verdienst um die Erforschung südslavischen Volksthums erworben. Wohl gelangten die meisten Fragen zur Beantwortung, dies allein konnte aber nicht genügen, deshalb sandte mich die Gesellschaft im Sommer des Vorjahres auf eine ethnographische Forschungsreise nach dem Balkan aus, damit ich an Ort und Stelle Erhebungen pflege.

Vor Kurzem habe ich meine Reise beendet. Ich begieng einen Theil von Slavonien und Dalmatien, hauptsächlich aber das Occupationsgebiet, Bosnien und die Hercegovina.

Der Weg den ich durchgemessen beträgt nicht viel mehr als Dreitausend Km. Auf den ersten Blick gewiss wenig im Verhältniss zu der aufgewandten Zeit. Im Flug und im Vorübergehen gewinnt man aber keine bedeutenden ethnographischen Ergebnisse. Hier gilt es unermüdlich beobachten und wieder beobachten. Die Geheimnisse des Volkslebens müssen abgelauscht, können nicht mit Hast ergriffen werden.

Ich bereiste die Flussgebiete der *Bosna* mit ihren Hauptzuflüssen der *Bobovača, Lašva, Tešanjka* und der *Spreča*, ferner das Gebiet der *Drina* und der *Drinača*, des *Vrbas*, der *Neretva* und der *Rama* und der *Cetina* und den grössten Theil des ebenen bosnischen Lavelandes.

Das hatte seinen guten Grund, denn längs der Flüsse wohnt immer eine dichtere und reichere ackerbautreibende Bevölkerung, bei welcher sich die Aeusserungen des Volksgeistes reger bethätigen als bei dem vereinzelt im Hochgebirge hausenden Hirten. Indessen besuchte ich auch das ganze Hochgebirge der *Majevica* und der *Treskavica planina* und zog von *Livno* über das Hochplateau von *Malovan* nördlich bis zu den Ausläufern des *Kunar*, des *Otrosa* und der *Orahovica*.

Der Reiseplan hätte gewiss noch zweckmässiger eingerichtet sein können, wäre es mir nur möglich gewesen irgendwie vor der Reise die ethnographischen Verhältnisse des Landes genauer kennen zu lernen. Wohl

bewahrheitet sich hier ein altes Wort in neuer Fassung: „Der Zigeuner, der Hausirer und der Ethnograph finden überall eine Auslese.“ Uebrigens lächelte mir auf meiner Reise sonniges Glück zu, indem ich ein ethnographisches Material in unerhörter Menge und von unschätzbarem Werthe aufgesammelt. Der blosse Abdruck dieses Stoffes dürfte bei sieben starke Bände in Grossoctav umfassen. Mehr als in flüchtigen Umrissen die Art dieses Stoffes anzudeuten, ist nicht möglich innerhalb des engen Rahmens dieses Vortrages.

Bosnien und die Hercegovina werden von nahezu 1,300,000 Seelen bewohnt. Davon sind bei 600,000 Mahomedaner, etwas weniger Altgläubige, bei 200,000 Katholiken und an fünftausend Juden, spanischer Abstammung. Letztere bedienen sich untereinander im Umgange eines verballhornten Spanisch, leben von der übrigen Bevölkerung streng abgesondert und haben ihre eigenen gesellschaftlichen und religiösen Gebräuche, die in Vielem von den Gebräuchen deutscher Juden abweichen.

Die allgemeine Landessprache besteht hauptsächlich aus zwei von einander unwesentlich verschiedenen Mundarten, der serbische-kroatischen Schriftsprache. Richtiger gesagt, die angenommene Schriftsprache ist ein Abklatsch der besonderen hercegovinischen Mundart, die von *Trebinje* und *Gacko* gesprochen wird.

Ethnographisch betrachtet hat man *ein* Volk vor sich, in Wirklichkeit aber begegnet man drei durch religiöse Anschauungen, Erziehung und Bildung streng abgesonderten Religionsekten. Nur dem Ethnographen gelten Sprachgrenzen als Grenzen eines Volkes. Eine solche Auffassung kann sich freilich nur bei einem geistig hochstehenden Culturvolke allgemeineren Eingang verschaffen.

Frägt man einen Deutschen oder einen Franzosen oder einen Engländer: ‚Was bist Du?‘ so wird der Deutsche antworten, er sei ein Deutscher, der Franzose ein Franzose, der Engländer ein Engländer. Frage man einen Bošnjaken und er nennt sich entweder einen Türken oder Altgläubigen oder Katholiken.

Seine Sprache heisst der Bosnier sowohl als der Hercegoviner die *bosnische* oder gewöhnlich *‚unsere Sprache‘ naški*. Diese „unsere“ Sprache wimmelt von allen möglichen türkischen, arabischen und zum Theil persischen, deutschen, griechischen, albanesischen, italienischen und magyarischen Bezeichnungen für die gewöhnlichsten Gegenstände des Alltagslebens. Jedes sechste Wort ist ein Fremdwort. Sowohl das Haupt- als das Zeitwort erfuhren dabei slavische Wandlungen. In syntaktischer Beziehung hat die türkische Sprache vielfach auf die slavische eingewirkt, so wie sich ein nachhaltiger Einfluss auch im Sagen und Märchenschatze des Volkes unverkennbar geltend macht.

Ein ethnographisches Curiosum bildet die handschriftlich weit verbreitete mahomedanisch-slavische Kunstliteratur. Es sind dies Lieder meist lehrhaften Inhaltes zu Schulzwecken nach arabischen Vorbildern angefertigt. Hier ist jedes zweite Wort ein Lehnwort. Form und Inhalt dieser Lieder widerstreben ganz und gar dem slavischen Geiste.

PROC. AMER. PHILOS. SOC. XXIII. 121. L. PRINTED OCTOBER 26, 1885.

Geschrieben sind diese Werkchen mit türkischen Schriftzeichen. Von den Mahomedanern sind wohl über 60% des Schreibens und Lesens türkisch kundig. Die altbosnische *Glagolica* ist gegenwärtig dem Volke unbekannt, nur in einigen mahomedanischen Adelsfamilien, z. B. bei den *Čengić* in Sarajevo und bei den *Ljubavić* in der Hercegovina noch im inneren Verkehr in Uebung. Da der Handel und das Gewerbe fast ausschliesslich von altgläubigen Serben betrieben wird, so ist es natürlich dass die cyrillische Schrift mehr als jede andere täglich an Verbreitung gewinnt. Der Bauer auf den Dörfern benützt dagegen Kerbstöcke, selbst zu Mittheilungen, statt eines Briefes, da die Kerbezeichen auf althergebrachten Ueberlieferungen beruhend, überall im Lande gekannt sind. Die Kerbe sind zum Theil der Glagolica, zum Theil den römischen Zahlzeichen nachgebildet. Auch rechnet der Bauer wesentlich mit römischen Zahlzeichen, wie der Römer vor 2000 Jahren.

In Bosnien wohnt der reichere Mahomedaner in einstöckigen, unsauberen Holzhäusern mit gewaltigen Thurmdächern. Erkennbar ist das Haus jedes Mahomedaners an der spitzen Wetterstange auf dem Dache und an der hohen Verzäunung, die den Einblick in den Hofraum wehrt. Arme Leute wohnen in niedrigen, schmutztriefenden Hütten. So sieht der verkörperte Jammer aus. In der Hercegovina sind bei Arm wie Reich die Behausungen nach dalmatinischer Art aus Stein gebaut, denn das Land ist zu dreiviertel gräulich entwaldet. Da kann man oft einen ganzen Tag reisen ohne einen schattenspendenden Baum zu finden. Die Hercegovina ist ein versteinertes Elend.

Die Städte sind nichts anderes als grosse Dörfer, deren Bewohner sich zumeist von Ackerbau und Viehzucht nähren. Die heimische Industrie arbeitet jetzt so wie vor Jahrhunderten und vermag kaum den Bedürfnissen der anspruchslosen Bevölkerung gerecht zu werden. Da die Städte zumeist an den Abhängen steiler Anhöhen oder in Schluchten erbaut sind, wo sie von starker Befestigung beschützt wurden, so ist nur bei wenigen Städten Wachsthum und Entwicklung von Vorneherein möglich. Ungesund und unrein sind alle, sammt und sonders.

Die Dörfer bestehen aus weit von einander abgelegenen Gehöferschaften, von welchen manche für sich ein kleines Dorf bilden, da noch die Hausgemeinschaft mit zahlreichem Kopfbestande ziemlich häufig ist. So z. B. leben in dem Dorfe *Gornja Dragunja* bei Srebrenik sieben verheiratete Brüder Martinović sammt ihren Nachkommen und Seitenverwandten in einer Hausgemeinschaft. In der Hercegovina ist diese gesellschaftliche Einrichtung weitaus seltener, weil die Lebensbedingungeu für grosse Familien von der Natur nicht gegeben sind. Indessen bildet als Ersatz für die Hausgemeinschaft die Bruderschaft (*bractvo*) und der *Stamm* (plene) ein die kleineren Hausbestände einigendes Band.

Bedeutsam sind unter den Baulichkeiten im Lande die zahllosen Rundthürme mit Auslugwarten und die zerfallenen Burgen, deren man überall welche findet.

Auf jedem Hügel, auf jeder Anhöhe mit weitem Fernblick steht noch

oder stand einst eine Veste. Selten sind welche Namen von den Ruinen bekannt, man nennt sie einfach bloss *Kula* oder *Grad*.

Ebenso wenig oder, genau gesagt, gar nichts weiss das Volk über die altbosnischen Gräber und Tunnele sachliches zu berichten. Solcher Gräber sah ich an 12,000; ihre Zahl in Bosnien und der Hercegovina dürfte leicht das Dreifache davon betragen.

Dieses Dunkel über die Vergangenheit findet darin seine Erklärung, dass die alte Bevölkerung von Bosnien und der Hercegovina vor zweihundert Jahren einem mächtigen Andrange neuer Ansiedler weichen musste.

Nachdem die mahomedanischen Slaven, die doch den Grundstock der türkischen Macht in Europa bildeten, Ungarn, Kroatien und Slavonien räumen mussten, zogen die mahomedanischen Likaer in die obere Krajina von Banjaluka bis Udbina, *Skoplje*, *Livno* und *Glamoč*; die slavonischen Mahomedaner besiedelten die Hercegovina und Mittelbosnien, während die Mahomedaner aus Ungarn das ganze Drinagebiet, sowohl auf der serbischen Seite als auf bosnischer, von *Rača* bis *Srebrenica* und die *Treskavica* bis *Olovo* und *Maglaj* und die Romanija für sich in Anspruch nahmen. Die christliche Bevölkerung musste diesem Ansturm weichen. Zu jener Zeit wanderten die Bosnier nach Slavonien und Kroatien, die Hercegoviner nach der Cruagora, Serbien und Dalmatien aus. Dagegen zogen gegen die Mitte des vorigen Jahrhundertes bei hunderttausend Dalmatiner nach Ostbosnien ein. Also erklärt es sich, wie in Slavonien die alte *ikavische* und in *Dalmatien* die kroatische *čakavische* Mundart durch die bosnisch-hercegovinische verdrängt worden, während die letzere durch ihre weite geographische Ausbreitung zur allgemeinen Verkehrssprache der Südslaven sich erhob.

Ueber diese Vorgänge erhält man durch die Heldenlieder, die zu den Gusle gesungen werden, klarsten Aufschluss, denn die Auswanderer und Einwanderer haben die Thaten ihrer Vorfahren getreulich im Liede verewigt. Kein Volk der Erde kann sich eines so reichen Schatzes epischer Lieder berühmen als die Südslaven, und zwar unter diesen besonders die Bosnier und noch mehr als diese die Hercegoviner.

Ich allein notirte über 60,000 Verse bloss des epischen Volksliedes und zwar hauptsächlich des mahomedanisch-slavischen.

Das Epos des katholischen Bosniers ist ganz verkümmert, wie denn überhaupt der Katholike unter der strengen Bevormundung von Seiten seiner Geistlichkeit am Wenigsten alte slavische Sitten und Bräuche beibehalten.

Unendlich reichhaltiger und mannigfaltiger ist das Volksleben der Altgläubigen, die sich Serben nennen. Ihre Geistlichkeit ist nicht zum geringsten Theil so gut wie illiterat und unterschied sich bis vor der Occupation äusserlich durch nichts als durch langen Bart und lange Haare von der übrigen Bevölkerung. Der Priester war Bauer, Wirth oder Kaufmann, wie sonst einer im Lande.

Das kirchliche Ceremoniell übte keinen bedeutenden Einfluss aus, so

dass der Bauer an uralthergebrachten heidnischen Vorstellungen noch immer festhält. *Vile* (Waldfräulein), *Divi* (Riesen), *Mora* (die Trut oder Mar), *Vještice* (Hexen) und noch eine schwere Menge derartiger mystischer Gestalten sind ihm gerade so wie den Mahomedanern thatsächliche Wesen. Noch feiert der Serbe, wie sein Urvorfahr vor eintausend Jahren, das Sippenfest und das Fest der winterlichen und sommerlichen Sonnenwende.

Alle drei Sekten huldigen aber einem gemeinsamen Alltags-Aberglauben, einem wahnwitzvollen Gemisch unverdauter östlicher und westlicher Angstbrauereien.

Mädchenraub oder, milder gesagt, Entführung kommt noch ziemlich häufig vor und gilt als Heldenthat. Polygamie gestatten sich nur reichere Mahomedaner. Das Weib ist dem Bošnjaken ein unbesoldeter Knecht für Alles.

Merkwürdig ist auf jeden Fall der überhandnehmende Brauch, dass das Mädchen von selbst zu ihrem Auserwählten ins Haus kommt. Eine solche wird *samodošla* oder *uskočica* genannt. Die Trauung findet oft erst nach Jahren statt. Dabei ersparten die Eltern die Ausstattung, der Bräutigam den kostspieligen Hochzeitsschmaus.

Das epische Lied des Serben is wesentlich ein Rachegesang des Unterdrückten und Verzweifelten, der den Mahomedaner für vogelfrei erklärt. Daraus haben sich Rechtsanschauungen heraus entwickelt, die vielfach von den altslavischen abweichen. Ein grosser Theil dieser Lieder ist nach einer gewissen Schablone gearbeitet und strotzt von sagenhaften Uebertreibungen. Uebrigens ist der Grundstock dieser Lieder schon früher gesammelt worden.

Es ist kein Uebelwollen, wenn ich behaupte, dass man auf Grund dieser serbischen Lieder das südslavische Volksthum in seiner Allgemeinheit nicht beurtheilen darf. Mir war es gegönnt, an einem unendlich reicheren und klareren Borne der Volksdichtung zu schöpfen und zwar die mahomedanisch-slavische Epik zu entdecken.

Der slavische Mahomedaner stand zu dem Sultan in Konstantinopel im Verhältniss des Feudalherrn gegenüber dem obersten Lehensgeber. Die Lehenspflicht bestand darin, dass der Slave die Reichsgrenzen gegen Deutschland zu vor feindlichen Einfällen bewachen musste. Sonst war er unumschränkt Herr und Gebieter und durfte selbst auf eigene Faust Feldzüge unternehmen. Hier lernt man den Südslaven als Sieger in grossen Kriegsunternehmungen kennen—einen Slaven, der abenteuerlustig bis nach Italien, Malta und Egypten zur See, und zu Lande bis Hermannstadt und Wien vordringt, und seine alte Sitte und seiner Vorfahren Brauch als Panier hochhält. Der Mahomedanismus war zu jener Zeit für den Slaven nur ein Deckmantel; deshalb spielt das religiöse Moment bei den Kriegszügen fast gar keine Rolle. Hier haben wir ein allseitig ausgebildetes slavisches Ritterthum vor uns, mit allen den uns durch mittelalterliche Dichtung wohlbekannten Ritterspielen, Gelagen, Mädchenpreisen bei Wettrennen und dergl. Und auch der Sänger fehlte nie.

Nur der Freie hat ein freies Lied. Der slavische Mahomedaner ist mit Nichten der Fanatiker, als den ihn Priester anderer Religionen verschrieen. In seinen Liedern erkennt er des Nichtmahomedaners Tugenden ebenso gerecht an als wären es die seinigen. Selbst der eigenen erlittenen Niederlagen schämt er sich nicht. Sein Epos ist, wie das der alten Griechen, objectiv gehalten, grossartig in der Darstellung und zuweilen von einer bedeutenden Gedankentiefe. Welch gewaltige Selbstironie liegt z. B. in den Worten, mit welchen der Sänger die Schilderung einer Schlacht bei *Mohač* abschliesst:

Bilojada i tamo i amo.
Sve je polje Khrvca potopila,
Crna khrvca turska ko i vlaška.
Tupo khrvi vlah i turčinbraća.

Jammer gab es drüben so wie hüben.
Ueberschwemmt vom Blute war das Schlachtfeld.
Schwarz ist gleich das Blut von Christ wie Türke,
Türke und Christ sind hier durch Blut verbrüdert.

Das mahomedanisch-slavische Lied gestattet uns den weitesten Einblick in die Verhältnisse der engeren Familie, der Sippe und des Stammes. Die Rechtsverwicklungen, welche Anlass zu verschiedenen Fehden geboten, und wie diese Fehden ausgetragen wurden, machen uns mit den slavischen Rechtsanschauungen auf's Eingehendste vertraut, zeigen uns den Südslaven als bedeutsames Glied in der Kette indogermanischer Völkerschaften.

In Mostar erscheinen in wenigen Tagen zwei Büchlein solcher Lieder und in Ragusa werden gegenwärtig zwei grosse Epen gedruckt, von welchen das eine, *Smailagić Meho*, 2173 Verse, das andere, *Golotinja Bogjulagić Ibro*, 1725 Verse zählt. Ein reichhaltiger Commentar erleichtert das Verständniss der Dichtungen. Die zwei letzteren Epen behandeln Episoden aus der Abenddämmerung türkischer Macht in Ungarn, wo die Tüchtigkeit der türkischen Waffen schon der Vergangenheit angehörte, wo der mahomedanische Slave allein noch der Schützer des Reiches war. Hätte sich durch irgend einen Zufall das ganze Südslaventhum um die grüne Fahne des Propheten geschaart, wohl wäre die serbische Sprache von Wien bis Konstantinopel zur allgemeinen Volkssprache geworden. Die tausend slavischen Lehnworte im magyarischen Sprachschatze sind während der hundertundsechzigjährigen mahomedanisch-slavischen Herrschaft in Ungarn aufgenommen worden, nicht aber, wie man annimmt, zur Zeit der magyarischen ersten Einwanderung. Aus diesen Liedern erwirbt man Kenntniss über ethnographische Verhältnisse einer Zeit, über die uns sonst keine ausreichenden Nachrichten zur Verfügung stehen.

Doch nicht bloss inhaltlich, sondern auch formell, sind die mahomedanisch-slavischen Lieder bemerkenswerth. Diese Lieder sind Meisterstücke

volksthümlicher Erzählungskunst. Nicht fünf Verse könnte man daraus ausscheiden, ohne das Ganze zu schädigen. Solche Schöpfungen eines urwüchsigen Volksgeistes gehören, ebenso wie die Homerischen Gesänge und das Nibelungenlied, der Weltliteratur an.

Ausser den 60,000 Versen meiner Sammlung erlangte die Gesellschaft von Herrn Prof. *Miroslav Alačević* in *Spalato* eine ungedruckte Sammlung dalmatinischer epischer Volkslieder. Diese Sammlung zählt über 30,000 Verse. Ferner sind uns noch von anderen Correspondenten von allen Seiten des slavischen Südens über 50,000 Verse, nebst zahlreichen anderen Beiträgen zur Volkskunde eingeschickt worden, so dass wir mit gerechtem Stolze behaupten dürfen, dass durch die Verarbeitung und Veröffentlichung dieses gewaltigen Stoffes das Südslaventhum in ethnographischer Hinsicht endlich auch eine der neuen Wissenschaft würdige Beleuchtung erfahren wird. Das kann dann, als das endgiltige Ergebniss meiner Reise gelten.

Catalogue of the Species of Batrachians and Reptiles contained in a collection made at Pebas, Upper Amazon, by John Hauxwell. By E. D. Cope.

(*Read before the American Philosophical Society, October 2, 1885.*)

The contents of a previous collection made at Pebas by Mr. Hauxwell are enumerated in the Proceedings of the American Philosophical Society for 1870, page 553. It included ten species of batrachians, four of lizards, and nine of snakes. The present collection embraces six species of batrachians, eleven of lizards, and fifteen species of snakes. The total number of species obtained is, fifteen batrachians, fourteen lizards, and twenty-three species of snakes. A considerable collection was made in the same region by the late Professor Orton, and the species are enumerated and described in the Journal of the Philadelphia Acadamy of 1875, p. 159. A previous collection, made by Professor Orton, is described in the Proceedings of the Philadelphia Academy for 1868, and one from Western and Central Peru is reported on in the Proceedings of the American Philosophical Society for 1877. These collections form the basis of a general review of the herpetology of Peru, which the writer hopes to publish with illustrations at no distant day.*

* Some species were obtained in the same region by Prof. Steere of Ann Arbor, Mich., and my thanks are due to this gentleman for the opportunity of examining them. From near Tarapota come the following species: *Dendrobates trivittatus* Spix; *Leptodactylus pœcilochilus* Cope; *Neusticurus ecpleopus* Cope; *Polychrus marmoratus* L. From Tombez: *Bufo hæmatiticus* Cope; *Hyla phæota* Cope.

From the Mamoré River in Eastern Bolivia, Dr. E. R. Heath presented to the museum of Ann Arbor the following species: 1. *Amphisbæna alba* L.; 2. *Pseudoëryx mimeticus* sp. nov. The genus Pseudoëryx Tsch., 1826, is the *Hydrops* Wagler, 1830, and *Dimades* Gray, 1843. It includes two banded species, the present

Batrachia.

Hyla favosa, sp. nov.

The internal nares are about as large as the choanæ, and are a little longer than wide. The patches of vomerine teeth are between them, opposite a point anterior to their middle. The head is short and wide, and the canthus rostralis is rounded and concave. The muzzle is truncate viewed in profile, and the nostrils, though opening laterally, are terminal in position. The tympanum is small, being one-half the long diameter of the eye-slit, or a little less than half that of the eyeball. It is a little larger than the digital palettes of the anterior foot. On all the upper surfaces the skin is smooth. The usual areolation covers the abdomen and part of the femora. The three external fingers are about half webbed, the web not reaching the palettes of the third and fifth digits. The toes are more than half webbed, the membrane reaching the dilatations of all the toes except the fourth, where it reaches the base of the penultimate phalange. When the posterior limb is extended, the heel reaches the front border of the orbit. The upper arm is bound to the side for the greater part of its length by a strong extension of the skin. A trace only is seen at the anterior base of the femur.

one and the *P. plicatilis* Linn., and two ringed species, the *P. martii* Spix and *P. callostictus* Gthr. The *P. mimeticus* has a remarkable resemblance to the *Hydrocalamus quinquevittatus* (D. & B.) Cope, Proceeds. Amer. Philos. Soc., 1884, p. 176. The scuta of the head are as in the *P. plicatilis*. Dorsal region brown for a width of five and two half rows of scales. Sides, on the third and fourth and half of the second and fifth rows, marked with a black band, which extends from the orbit to end of the tail, and is yellow-bordered above. Below yellow with two small brown spots on each gastrostege and one on each urostege. Lips black, yellow spotted; a yellow band from eye to angle of mouth. A few small blackish spots on top of muzzle. Gastrosteges 163; anal 1-1; urosteges 35. Total length M. .490; of tail .056. 3. *Liophis almadensis* Wagl. 4. *Herpetodryas fuscus* Linn. 5. *Xenodon bipræoculis*, sp. nov. Body much compressed, and scales in nineteen longitudinal rows, and scarcely alternating. Anal plate entire. Eye large, profile convex. Superior labials eight, fourth and fifth entering orbit; seventh very wide above. Oculars 2-2, the anterior narrow, permitting the posterior angle of the large loreal to almost reach the orbit. Temporals 1-3; the anterior as deep as long. Both internasals and prefrontals a little wider than long. Frontal large, wide in front, longer than common suture of parietals. Parietals as wide as long. Ten inferior labials, the sixth much the largest. Genials very short, the anterior a little the longer. Gastrosteges, 136; urosteges, 44. Color above olivaceous with three rows of equidistant spots. These are composed of coarse, black punctulations, and are without definite outline. Every third spot of the median line is in the centre of a pale ground, while the pairs between are connected by a dark shade. Inferior surfaces yellow; every other, or every second gastrostege, with a blackish edging at each end. Top of head olive, with black punctulations symmetrically arranged, so as to leave a curved unspotted space between the orbits and on the external border of the parietals. Labial plates unspotted. A very narrow black line from eye to superior border of last labial. Total length M. .590; of tail, .101. From its compressed form and natural coil, this species might be supposed to have arboreal habits. It agrees with three other species in its entire anal plate; vis., *X. suspectus* Cope; *X. colubrinus* Günth; and *X. angustirostris* Pet. In *X. rhabdocephalus* Boie, I find the anal plate entire or divided. 6. *Elaps surinamensis* Cuv.

The color of the upper surface is a brown, which is interrupted by a coarse honeycomb or net-like pattern of a bright yellow color. The inclosed spaces are as large or larger than the eye, excepting on the sides of the head and body and on the forelimbs, where they are smaller. They are distinct on the external two digits on both feet. The posterior faces of the femur, with all the inferior surfaces are uniform brown. The eyelids are of a paler brown, but whether this is due to the condition of the specimen or not, is uncertain.

Measurements.

	M.
Length of head and body	.635
Length to line connecting posterior borders of tympana	.010
Width of head at do	.012
Length of fore limb	.0233
" " " foot	.010
" " hind limb	.056
" " tibia	.019
" " posterior foot	.026
" " astragalus	.011

This species belongs to the same type as the *Hyla leucophyllata*. Its coloration is unique in the genus. An allied species or subspecies has been brought from the Purus river, Brazil, by Prof. Steere, of Ann Arbor, Mich. It agrees in all respects with the *H. favosa*, but the heel reaches the end of the muzzle, and the color of the superior surfaces differs. The yellow covers the dorsal region, an imperfect reticulate pattern being only visible on the sides of the head and body.

HYLA MARMORATA Daud.

PITHECOPUS TOMOPTERNUS Cope.

CERATOPHRYS DORSATA Wied.

DENDROBATES TINCTORIUS Schn.

DENDROBATES TRIVITTATUS Spix.

LACERTILIA.

MABUIA AGILIS Raddi.

MIONYX PARIETALIS Cope, gen. et sp. nov.

In his monograph of the Ecpleopodine division of the Teidæ, Professor Peters referred the known species to five genera, three of which were divided into subgenera. The definitions of most of these groups were derived from the pholidosis, the exception being Iphisa (Gray), which was defined by the lack of claws on the pollices. I am of the opinion that Professor Peters was not fortunate in his selection of the pholidosis as the basis of generic and subgeneric divisions. Although such a system may associate species which agree in general appearance, and hence be thought by some to be "natural," it is certain that the various forms of scales pass into each other by such gradations, as to be unavailable for the

characterization of tangible divisions. On the other hand, Professor Peters quite overlooked important characters of the squamation of the head, such as are usually found to distinguish natural genera in other families, including them only in his descriptions of the species. I propose to give a synopsis of the genera of this group as they appear to me. One result is a considerable reduction in the number of names. Agreeing with Dr. Boulenger that these species do not form a family distinct from the Teidæ, I define them as a group in that family with the nostril pierced in a single plate.

I. "Thumbs without claws."

A series of scuta on the nape; frontonasal and frontoparietal scuta present. *Iphisa* Gray.

II. Claws all straight, conic.

No nucleal scuta; frontoparietals and frontonasals present.. *Mionyx* Cope.

III. Claws curved, present on all digits.

a. Dorsal series of large scuta.

Scuta in separate longitudinal series; forming keels on the tail..... *Neusticurus* D. & B.

Scuta continuous, transverse; frontonasal and frontoparietal scuta..... *Placosoma* Tsch.

aa. No larger series of dorsal scuta.

Frontonasals and frontoparietals present.....*Leposoma* Spix.
Frontoparietals, but no frontonasals.....*Proctoporus* Tsch.
No frontoparietals or frontonasals .....*Emphrassiotis* O'Sh.

In the above arrangement there is included, under Iphisa, *Perodactylus* R. & L. Leposoma includes nearly all the reputed genera of Peters and other authors, viz: *Loxopholis* Cope; *Cercosaura* Wagl.; *Pantodactylus* D. & B.; *Ecpleopus* D. & B.; *Aspidolæmnus* Pet.; *Euspondylus* Tsch.; *Argalia* Gray (Peters); *Chalcidolepis* Cope; *Xestosaurus* Pet.; and *Pristidactylus* O'Sh. Proctoporus Tsch. includes *Pholidobolus* Pet., *Oreosaurus* Pet., and species referred to Ecpleopus by O'Shaughnessy. Of the species referred to the group Leposoma, as originally restricted, but two have the abdominal scuta acute posteriorly, viz: the *L. scincoides* Spix, and the *L. carinicaudatum* Cope. The other species referred by O'Shaughnessy and Peters to that group have, according to them, the abdominal scuta truncate posteriorly, and must hence be referred to the group Loxopholis Cope, of which *L. rugiceps* Cope is type. These are the *L. dispar* Peters, and *L. buckleyi* O'Sh. The species thus arranged will be as follows:

Mionyx parietalis Cope.
Iphisa elegans Gray.
" *modesta* R. & L.
Neusticurus bicarinatus L.
" *ecpleopus* Cope.
Placosoma cordylinum Tsch.
Leposoma scincoides Spix.
Leposoma carinicaudatum Cope.
" *rugiceps* Cope.
" *dispar* Pet.
" *buckleyi* O'Sh.
" *ocellatum* Wagl.
" *humile* Pet.
" *olivaceum* Gray.

Leposoma reticulatum O'Sh.
" *picticeps* Cope.
" *vertebrale* O'Sh.
" *schreibersii* Wiegm.
" *bivittatum* Cope.
" *concolor* Tsch.
" *argulus* Pet.
" *gaudichaudi* D. & B.
" *affinis* Pet.
" *maculatum* Tsch.
" *rhombiferum* Gthr.
" *acutirostre* Pet.
" *ocellatum* Gray.
" *strangulatum* Cope.
Leposoma guentheri O'Sh.
" *olivaceum* Gray.
" *marmoratum* Gray.
" *pœcilochilus* L. & Von M.
" *metallicum* Cope.
" *bogotense* Pet.
Proctoporus pachyurus Tsch.
" *unicolor* Gray.
" *fraseri* O'Sh.
" *oculatus* O'Sh.
" *montium* Peters.
" *striatus* Pet.
" *luctuosus* Pet.
Emphrassiotis simoterus O'Sh.

The species number as follows:

Mionyx	1
Iphisa	2
Neusticurus	2
Placosoma	1
Leposoma	28
Proctoporus	7
Emphrassiotis	1
Total	42

The characters of the genus Mionyx are the following: First toe of both anterior and posterior extremities with rudimental straight claw; claws of other digits small, straight and conic. Prefrontal and frontoparietal plates present and distinct from each other. Ear-drum exposed. No distinct collar. Femoral pores present. Pholidosis squamous, nearly homogeneous.

Char. specif. These resemble those of the group Leposoma within that genus. The scales are imbricate and keeled, with acute posterior borders above and below. When the epidermis is lost the inferior scales are nearly truncate.* The dorsal and ventral scales are subequal and form twenty-one transverse series between the anterior and posterior limbs, across the back. Behind the auricular meatus, and in the axilla, they are coarsely granular. The upper and lower arms are covered with large keeled scales, although those of the posterior side of the former are smaller than those on the anterior side. The hind leg is similarly surrounded by large keeled scales, excepting on a band on the posterior side of the femur where they are granular.

There is a transparent disk of the lower eyelid, which is covered by two scales. The plates of the head are smooth. There is a loreal plate

* The truncation of the abdominal scales in the *L. rugiceps* is seen in the epidermis as well as the true skin.

which is higher than long, and projects at an angle between two preoculars. Of these the superior is large and extends partly over the eye, leaving only three narrow superciliaries. There are four well-developed supraorbitals. The large internasal is about as wide as long. The frontonasals are well in contact by suture. The frontal is considerably longer than wide, as are also the frontoparietals. The interparietal is large, as wide as long, and would be a regular hexagon, but that the posterior border is rounded. The parietals are much smaller and trapezoidal, and longer than wide. No occipitals. Temporals small, squamous. Superior labials seven, separated from the orbit by a row of narrow suborbital scales. Inferior labials five. A symphyseal and an undivided postsymphyseal. Four infralabials, of which the first two are in contact, and the last two separated by flat scales, the fourth truncate posteriorly; no distinct pectoral scales.

The limbs are slender; when pressed to the side, the fingers reach to the middle of the tibia, and the toes to a little beyond the elbow. The toes themselves are weak and slender. The first digit is rudimental, and the second and fifth are very short, and of subequal length on the fore foot; and on the posterior foot, the second is a little the longer. The third digit is shorter than the fourth on both feet. They are all protected by a single row of flat scales below. The femoral pores extend entirely across in front of the anal scuta; there are ten on each side of the middle line. Of anal scuta there are six, arranged as follows: Two small ones on the middle line, one of which is marginal, and the other anterior to it; one large one on each side of these, also marginal; and a small one on the external side of these, also marginal.

Color, brown; dark above, pale below, darkest on the sides. The exact color is probably lost, as the specimen is not in the best condition. Side of head with some yellow spots. Lips and throat white, the former with a dark brown spot on some of the labial scuta.

Measurements.	M.
Length from muzzle to vent	.032
" " " to axilla	.015
" " " to auricular meatus	.0075
Width at auricular meatus	.005
Length of fore limb	.0105
" " hand	.0035
Length of hind limb	.0145
" " tibia	.0048
" " foot	.0056

LEPOSOMA PICTICEPS, sp. nov.

Dorsal scales very narrow, in regular cross-series, the acute extremities of those of one row alternating with those of the rows in front and posterior; each with a strong epidermal keel which is represented by a weak one of the true skin. These scales commence at the interparietal plate,

and present nine transverse series to the axilla, and twenty from the axilla to the groin. The scales of the tail are similar. The abdominal scales are smooth and parallelogrammic, being truncate behind, and are in sixteen transverse rows between the axilla and groin. A rather wide space posterior to the auricular meatus, and posterior to the axilla is covered with granular scales. The larger and square scales of the throat are in four transverse rows of two scales each. They are separated from the cross-row that marks the axilla by two cross-rows, and are bounded by some flat scales in front and at the sides.

The internasal plate is a little wider than long. The frontonasals are well in contact. The frontal is longer than wide. The frontoparietals are as wide as long, and are regularly five-sided, the supraorbital side a little longer than the others. The interparietal is nearly three times as long as wide. The parietals are larger and their posterior border forms, with that of the interparietal, a straight line. The posterior exterior border is excavated. The loreal is higher than long, and presents an obtuse angle posteriorly between the two preoculars. Of these the superior extends posteriorly over the eye, leaving three narrow superciliaries. Three supraoculars, the posterior with a small round plate posterior to it. Temporal scales rather large, smooth; no free marginal meatal scales. Seven superior labials; six inferiors. A short symphyseal and a long postsymphyseal, both undivided. Posterior to the latter two pairs of large infralabials, touching on the middle line, followed by a large pair of infralabials which are separated on the middle line, each of which is followed by two large and some smaller scales.

Limbs rather short, posterior feet elongate. The fingers reach to the heel when both limbs are pressed to the side of the body, and the toes to the middle of the humerus. The limbs are covered by large, smooth scales, except on the posterior faces of the humerus and tibia, where they are smaller, and on the posterior face of the femur where they are granular. The claws are present on all the digits and are curved. Second and fifth fingers equal. Second toe longer than fifth, and fourth a good deal longer than third. Seven femoral pores and two preanals on each side. Preanal plates, seven. Of these six are marginal, a large one with a small one on each side of it, on each side of the middle line. The seventh is in front of the two median marginals, and is a large triangle.

Color, olive-brown or grayish, shaded with blackish on the head. The plates of the head have pale borders and centres, and the rostral and labial plates are yellow, the latter with a dark brown spot in the centre. A light (? yellow) band over the eye, and two rows of similar spots on the temporal region. Several rows of similar dark-edged spots on the nape. Granular region black, with yellow spots. The spots fade out on the dorsal region, each cross-row of scales has a blackish edge. On the tail two rows of such spots can be made out on each side. Inferior surfaces pale, probably yellow; lower labials, and the posterior infralabials with a dark brown spot in the centre.

Measurements.	M.
Length from muzzle to vent	.057
" " " " axilla	.025
" " " " auricular meatus	.012
Width at auricular meatus	.0076
Length of fore limb	.015
" " hand	.0065
" " hind limb	.026
" " tibia	.007
" " foot	.0132

This species is evidently nearly related to the *Leposoma reticulatum* of O'Shaughnessy (*Cercosaura reticulata* O'Sh., Proceedings Zoöl. Society London, 1881, p. 230). It differs in not possessing the following characters of that species, as described and figured. In *L. reticulatum* there are two parietal plates on each side; abdominal scales are rounded in posterior outline, and in only eight rows, while they are in ten in *L. picticeps;* in having an azygous marginal anal instead of two, and in having a stripe on the body, and the tail differently colored from the back. The type of *L. picticeps* is a considerably larger animal than that of the *L. reticulatum.*

CENTROPYX DORSALIS Gthr. *Monoplocus dorsalis* Günth. *Centropyx pelviceps* Cope.

Mr. O'Shaughnessy finds these supposed species to be identical. Dr. Günther having established a new genus (Monoplocus) for the species on the supposed absence of femoral pores, I did not think it worth while to compare my specimens, in which they are numerous, with the one described by Dr. Günther. Mr. O'Shaughnessy has discovered that Günther's type possesses the pores.

AMIVA SURINAMENSIS Gray.

HYPSIBATUS AGAMOIDES Spix.

HYPERANODON PELTIGERUS Cope.

ENYALIUS LATICEPS Guich.

ANOLIS BUCKLEYI O'Sh.

ANOLIS BOUVIERI Boc. O'Sh.

ANOLIS MACROPUS, sp. nov.

Tail subround, without crest. Ventral scales small, smooth; dorsal scales minute, rough. Occipital scale small, well separated from supraorbitals; the latter separated from each other by three rows of scales, and not continued as a larger row anterior to orbit. Interorbital region concave; facial rugæ obtuse, separated by a concavity. Facial scales small, keeled, about twenty longitudinal rows at the middle of the muzzle, and ten in the facial concavity. No distinct canthus rostralis, and but two canthal scales distinguishable from those of the muzzle in size. Supraocular disk embracing a dozen scales of unequal sizes, and

surrounded by granules. Seven or eight loreal rows; labials, $\frac{8}{10}$; infralabials all small. Auricular meatus small, but larger than occipital scale. The limbs are slender and long. The anterior appressed reaches the end of the muzzle by the end of the fifth digit; the posterior reaches the same by the end of the fourth digit. Digital dilatations narrow. Fan small.

The general color is blackish, below white, the line of junction of the colors on the sides of the belly, and ragged. A pale line across the chin.

Measurements.	M.
Length of head and body	.045
" to posterior border of meatus auditorius	.061
Width at posterior border of meatus auditorius	.0065
Length of fore leg	.021
" " fore foot	.0072
" " hind leg	.041
" " tibia	.0125
" " hind foot	.017

This species approaches most closely the *A. limifrons* Cope from Veragua. In that species the facial rugæ have distinct large scales, which are wanting in the *A. macropus*, and the hinder legs are not so long. The facial scales are a good deal smaller, and the posterior legs shorter in *A. macropus* than in the *A. trachydèrma*, which it otherwise resembles. The long hind legs distinguish it from other allied species.

OPHIDIA.

TYPHLOPS RETICULATUS L.

BOA CONSTRICTOR L.

RHABDOSOMA BREVIFRENUM Jan.

RHABDOSOMA MICRORHYNCHUM Cope.

CONTIA SERRATA, sp. nov.

RHADINÆA NICAGA Cope, *Lygophis nicagus* Cope, Proceeds. Phila. Academy, 1868, p. 132. Proceeds. Amer. Philosoph. Soc., 1870, p. 553.

Scales in seventeen rows, without fossæ, all of moderate width, the first not very wide. Eight superior labials, third, fourth and fifth entering orbit; fifth, sixth and seventh largest, subequal, their superior borders increasing in length in the order named. Rostral plate very small, barely visible from above. Nasal decurved forwards, deeper posteriorly; loreal deeper than long; ocular 1–2; the preocular narrow and widely separated from the frontal above. Temporals 1–2; the anterior in contact with the inferior postocular only. Internasals small, as wide as long; prefrontals much larger, wider than long. Frontal elongate, truncate in front, and with parallel sides; parietals long and large, extending on each side to the inferior postocular. Gastrosteges 160; anal divided; urosteges 52. Total length, M. .245; to rictus oris, .0065; of tail, .070.

Color above dark brownish-gray. A line of darker color extends along the third row of scales, and a similar one on the eighth row, which leaves

the ninth or median row of the ground color. These lines are quite indistinct. Ends of the gastrosteges of the ground color, shaded with bluish, so as to give the color border a serrate outline. Under surface of body and tail yellow, immaculate. Top of head paler. The frontal plate with dark edges and some dark specks on the prefrontals. A pair of light dark-edged small spots, close together, one on each side of the common parietal suture. Superior labial dark-edged. Lower labials and adjacent plates obscurely speckled.

Near the head the dorsal lines unite and form a serrate dorsal band, which is separated by a paler band from a darker lateral band with the superior edges serrate; but these markings are obscure. In another specimen which Prof. Steere, of Ann Arbor, brought from the Purus river,* the dorsal band is more distinct and extends to the end of the tail.

I originally referred this species to (Lygophis) Aporophis, but its equal teeth exclude it from that genus.

OPHEOMORPHUS MELEAGRIS Shaw.

HELICOPS ANGULATUS Linn.

OXYRRHOPUS SCOLOPAX Klein.

DIPSAS CENCHOA L.

RHINOBOTHYRUM LENTIGINOSUM Scop.

LEPTOGNATHUS CATESBYI Weigel.

LEPTOPHIS MARGINATUS Cope.

DRYIOPHIS ARGENTEUS Daud.

ELAPS LEMNISCATUS L.

BOTHROPS BRASILENSIS Latr.

* This collection was made at Canutama, a distance of six hundred miles, and at Marrahan, a distance of seven hundred miles above its mouth on the Purus river, and as the first indication of the reptile fauna of that region possesses considerable interest. It includes the following species: 1. *Liophis almadensis* Wagl.; 2. *Rhadinæa nicaga* Cope; 3. *Pseudoeryx callostictus* Günth (*Hydrops*); 4. *Tortrix scytale* Linn; 5. *Bufo agua* L.; 6. *Hyla leucophyllata* var. Beir; and 7. *Lithodytes cinereus* sp. nov. This frog has a smooth belly and free toes with truncate pallettes on all the digits. There are no cranial crests, and but slight traces of dorsolateral dermal folds. The vomerine teeth are in J-shaped patches commencing opposite the posterior border of the choanæ, and curving inwards and backwards. Ostia pharyngea as large as choanæ. Nostril terminal. Tympanic drum round, two-thirds size of eye. Tongue oval, slightly notched behind. Head oval; muzzle truncate; lores straight, grooved; canthus rostralis distinct, straight. Heel of extended hind leg to end of muzzle. First finger longer than second. A prominent sharp metatarsal tubercle attached to base of first toe. No external tubercle. Color above gray, with pale brown markings. The most distinct of these is a cross-band between the orbits. Lower surfaces dirty-white; concealed surfaces brown. Upper lip with three yellowish spots extending from the orbit; to which two or three marks on the lower jaw correspond. Limbs faintly brown cross-banded. Length of head and body M. .053; width of head at tympana .018. Length of fore-leg .029; of hind leg .084; of hind foot .038.

A Sketch of the Life of Robert E. Rogers, M.D., LL.D., with Biographical Notices of his Father and Brothers. By W. S. W. Ruschenberger, M.D.

(*Read before the American Philosophical Society, November 6, 1885.*)

The life of Dr. Robert E. Rogers was interwoven in many ways with the lives of his brothers. All were able university professors. They labored jointly as well as separately to increase and diffuse knowledge. On this account they were more or less distinguished. All were members of the American Philosophical Society. All are dead. No obituary minute of either has been recorded in its archives.* Therefore it seems proper to group together sketches of the four brothers in such manner as may give to each, if possible, his characteristic features.

Each followed his routine course; but often they engaged jointly in one investigation, so that the public sometimes confounded their labors and gave credit to one which truly belonged to another. Their works were frequently mentioned at home and abroad as of "the brothers Rogers," and always in respectful and kindly terms. Mistakes of the sort never disturbed the perfect harmony that always existed between them, as they might have done had the brothers been rivals or competitors for reputation. Their days of boyhood were passed together in delightful companionship with their father, whom they regarded with profound respect. Their tastes and pursuits were similar. Their home-training taught them to love one another, so they went through life practising, unconsciously, no doubt, the affectionate ways which they had inherited and learned from their mother, a sensible woman of a gentle and loving nature.

From their earliest youth the brothers were ardent students, and learned to concentrate their energies to do in the best manner possible whatever they undertook. To them the axiom that whatever is worth doing at all is worth doing well, was an inflexible law. From the start they knew that their worldly success was contingent upon the quality of their work. They could look to no valuable bequest. None of their near kinsmen was

* Dr. Joesph Carson presented to the library of the Society a printed copy of a memoir, written by him, of the late James B. Rogers, M.D., and was excused from his appointment to prepare an obituary notice of Dr. Rogers for the Society.—*See Proceedings Am. Phil. Soc. Dec.* 19, 1856, *vol. vi, p.* 223.

opulent; none occupied high social or political station from which patronage might possibly flow to them. They had little patrimony besides those qualities which the human organism has when it comes into the world. And yet they might be justly thankful for their ancestral gifts, gifts which have no equivalent value in coin. Their organic inheritance included a healthy though not robust body, a sound mind, quick perceptivity and capability, a ready aptitude for toil, with many of the constituent attributes of that sort of nobility which needs neither title nor rent-roll to set it off. Titled ancestors had no part in the genesis of their endowments.

Robert Rogers, the fifth in lineal descent, was born about the year 1753, and lived on the Edergole, or Knockbrack estate, which he owned in fee, and held on lease acres of land adjoining. This estate lies between Omagh and Fintano, in Tyrone county, Ireland. Newtown Stewart, in the barony of Strabane, then a good market for cloth and yarn,* ten miles off, is the nearest town, and Londonderry, forty miles distant, the city nearest to it. The number of his tenants or extent of acreage held by him is not now known. His social grade in the community is not indicated by his estate alone. When the Presbyterian church which he attended was reconstructed, he rebuilt and furnished anew the large central pew in it, which he had inherited. He was disposed to favor what was then termed the new light doctrine, but tolerant enough to listen to the religious and political opinions ascribed to the French philosophers.

In the small villages and rural districts of Ireland at that period—more than a hundred years ago—those whose wardrobe was limited to a single suit and an extra shirt or two (and they were largely in the majority there, as well as everywhere), determined social position in the community by the interval between the family wash-days. In their estimation those whose wardrobe was extensive enough to have their washing done once a year constituted "the great families;" and those who needed to have a family wash-day every six months composed the second class in society. The washing of the Rogers family was done only twice a year, at the brook which flows through the estate.

In the winter of 1774-75, when twenty-one years old, Robert

*Statistical Survey of the County of Tyrone for 1801-2. By John McEvoy, Dublin, 1802.

Rogers married Sarah Kerr, of about the same age, who, tradition avers, was sprightly, conspicuous in conversation, and ever ready to discuss and advocate the new light doctrines of the Presbyterian Church, of which she was a member. This marriage had been delayed a year by her father, a recognized "gentleman" in the community, who insisted that Robert Rogers must attain his majority before he could lawfully make a marriage settlement of all his lands upon the children of this union, share and share alike, and that without compliance with this stipulation his assent to it would not be given.

Robert Rogers was a well-to-do Irish gentleman, liberal in his views, hospitable, convivial, and duly appreciated education and learning.

Patrick Kerr Rogers, the father of the subjects of this notice, was the first born, in 1776, of the twelve children of Robert Rogers and his wife Sarah Kerr. Four of them died infants.

The rudiments of Patrick's education were received in a school-house built upon the estate. It is described as having clay walls, a thatched roof, clay seats covered with bits of carpet and warmed by a turf fire. The teacher was a lame rustic boy, whom his aunt, Margaret Rogers, a lady of notable intelligence, had trained for the office.

It is conjectured that he acquired his classical learning from a private tutor at the house of a kinsman.

His mother died in 1790, and his father married again in 1791, a lady who bore him three sons and two daughters.

At the age when he should choose a profession, he found himself one of a numerous family of brothers and sisters and, though the eldest, without the right of primogeniture in his father's estate. Entertaining opinions not rigidly orthodox he was unwilling to enter the clerical profession, though he had the example of two uncles who were clergymen. At the time a commercial career seemed best, and therefore he entered a counting-house in Dublin. How long he lived there, or was thus employed has not been ascertained. But about the time of the Irish rebellion, which broke out in May, 1798, he contributed to Dublin newspapers articles inimical to the government, which, his friends believed, were likely to cause his arrest and punishment. A kinsman furnished the means which enabled

him to reach Londonderry and emigrate thence to the United States.

The indiscretion of those publications is manifest in their consequence. It brought expatriation, permanent separation from his kinsfolk and friends. But he was young, only twenty-two years old, sanguine, self-confident, earnest, and though usually cool and judicious in conduct, on critical occasions he acted indiscreetly—on the impulse of the moment.

He arrived in Philadelphia August, 1798, probably on the ship *Rising Sun*, after a passage of eighty-four days.

At that period ships plied directly between Ireland and Philadelphia. There was then quite a colony of people from the north of Ireland settled in this city. The risks many of them had run and escaped in unsuccessful efforts to resist the political oppression which exasperated and harassed them at home probably begot a fellow feeling, stronger than that of race affinity. The fugitive, no doubt, was cordially received, and at once made a welcome member of this Irish circle, which included persons of social influence.

In May, 1799, Mr. P. K. Rogers was appointed a tutor in the University of Pennsylvania, and probably in the same year began to study medicine under the immediate direction of Dr. Benjamin Smith Barton, Professor of Materia Medica, Natural History and Botany.

It is evident that a warm friendship between preceptor and pupil was soon established. In dedicating his thesis he ascribes to Dr. Barton's example, instruction and kindness any happiness he may enjoy, in the course of his life, from his attachment to the sciences connected with medicine, and declares that he cannot help regarding the day on which he became his pupil as truly auspicious.

Mr. Rogers was married by the Rev. George C. Potts,* January 2, 1801, to Hannah Blythe, an intelligent woman, a year older than himself, endowed with a cheerful and affectionate disposition. He is described then as a tall, erect man of grave

*The Rev. George Charles Potts had recently immigrated from Ireland. He had been a licentiate of the Presbytery of New Castle, Del., for some months, when he was ordained and installed the first pastor of the Fourth Presbyterian Church of Philadelphia, May 22, 1800, which was founded by about a score of Irishmen, June, 1799.—*A Historical Discourse, delivered at the Fourth Presbyterian Church, Philadelphia, Nov. 9, 1879, by Rev. George Benaugh.*

deportment, having dark hair well sprinkled with gray, and soft, sleepy eyes. He played the violin and sang well; but never in company or in the presence of strangers, because such performance or display seemed to him inconsistent with the dignity of a gentleman.

That those personal characteristics noted in this paper which are ascribable to heredity may be apparent, a summary of the bride's history seems desirable. It is conjectured that the female organism possesses even more genetic energy than the male—that the child is indebted to the mother as much at least as to the father for its engendered qualities. A distinguished botanist has observed that only the highest types of vitality in plants take the female form. "The law in this instance," he says, "seems clear, that with a weakened vitality comes an increased power to bear male flowers, and that only under the highest condition of vegetative vigor are female flowers produced."* He conjectures that this law of the vegetal also prevails in the animal world.

Hannah Blythe was the youngest daughter of James Blythe, native of Glasgow, but a resident of Londonderry, and his wife Bessie, a daughter of James Bell, an English citizen of Londonderry.

James Blythe was a publisher and stationer. He founded, in 1772, the Londonderry Journal, the first tri-weekly paper printed in the north of Ireland. It became a daily and is still published. No evidence of his right to this honor is recorded in it because, believing himself suspected of opposition to the government, and desiring to obtain the patronage of both political parties, he considered it expedient that his partner, a Mr. Douglas, who was a printer, should publicly appear to be the sole proprietor and editor. This is the reason assigned why his name was not recorded in connection with the enterprise. The paper was printed and issued from the house in which he lived. His daughter, Mrs. Ramsay, who died at the advanced age of ninety-two years, often mentioned among the reminiscences of her early childhood the gathering of a crowd reading a placard on the front of their house, headed, "Bloody News From America," announcing the

*On the sexes of plants. By Thomas Meehan, of Germantown, Philadelphia. Proc. Amer. Assoc. for the Advancement of Science. Salem Meeting, August, 1869, vol. 18, pp. 256-260.

battle of Lexington, April, 1775. She stated also that many Protestant citizens rejoiced over this resistance of Americans to the British administration.

James Blythe died in 1787, leaving a widow and three daughters, Elizabeth, Mary Ann and Hannah. The widow, Bessie Bell, who was an intelligent and energetic woman, removed to Strabane, about fifteen miles southward from Londonderry, took into partnership a foreman from the old establishment, set up and conducted a newspaper till she died, in 1794. The business was unprofitable. The daughters were left without support. They promptly determined to emigrate, and embarked in a ship belonging to their cousin, Adam Crampton, of Londonderry, and after a voyage of three months, arrived in Philadelphia the same year.

They were received by their cousin, wife of Thomas Moore, merchant, who had left Coleraine some time before on account of his affiliation with the "United Irishmen."

They are described as quick, active, intelligent women, and being like most ladies of that period, proficient in the use of the needle, set to work with it and supported themselves respectably and independently.

The city directory for 1802 states that P. K. Rogers, A.M., lived at No. 55 Lombard street, implying that he had established a home for himself very soon after his marriage. Where his degree of Master of Arts was conferred has not been ascertained.

In June, 1802, he received the degree of Doctor of Medicine from the Medical Department of the University of Pennsylvania. His thesis was on *Liriodendron tulipifera*, or poplar tree, in which he records the results of his experimental observations of its chemical and therapeutic properties.

Now he was a householder, with wife, infant son and a profession. He started to maintain and improve his condition. He obtained some practice, had private pupils, lectured to classes of students, demonstrated in public the exhilarating effects of the inhalation of nitrous oxide or laughing gas, which were discovered in 1800, by Sir Humphrey Davy, delivered popular lectures on botany and scientific subjects, and contributed histories of cases to Dr. Barton's Medical and Physical Journal. In successive years he gave a course of lectures upon the

History of Medicine and Medical Philosophy. Subsequently he devoted himself to chemistry, upon which he delivered, it is supposed, the first complete series of popular lectures ever given in this city, or in the country.

The death of his father, who was drowned in a brook which flows on the place, called him to Ireland in 1807. He sold the family seat and settled the bereaved second family on the leased lands. This business, which occupied some time, being completed, he returned to Philadelphia, bringing with him two younger brothers and a sister, and resumed his work.

In 1809 the professorship of chemistry in the University of Pennsylvania was made vacant by the death of Dr. James Woodhouse.

Dr. P. K. Rogers addressed a letter, June 12, 1809, to Dr. Benjamin Rush, from which the following are extracts. They are characteristic of the writer in some degree:

"The chemical chair being vacant, I intend to become a candidate for the professorship. Your influence in my behalf is the favor which I am anxious to obtain. It would bind me in chains of gratitude for life.

"My indigence has compelled me to make some attempts as a medical teacher, and unless some fortunate change should take place in my affairs, the same indigence may still urge me to the same exertions. Arrangements have been made in relation to my library which place it on a permanent foundation. Of course I will be enabled, as far as books can do it, to take a more advantageous stand as a private lecturer, or as a professor."

* * * * * * *

"I could wish to secure your patronage only by deserving it. As neither the professors nor trustees have had any adequate opportunity of judging of the real qualifications of candidates, I would be willing to deliver a series of experimental lectures in competition with others. I venture to mention this, because I hope the appointments are not solely regulated by the partiality of friends."*

Dr. John Redmond Coxe was elected to the vacant chair July 10, 1809.†

* MS. Correspondence of Dr. Benjamin Rush, vol. 22, R to W., Ridgway Library, Philadelphia.

† History of the Medical Department of the University of Pennsylvania. By Joseph Carson, M.D., Professor of Materia Medica and Pharmacy in the University of Pennsylvania. Lindsay & Blakiston, Philadelphia, 1869.

Dr. Rogers attempted to establish a circulating medical library in the city, and spent considerable part of his patrimony in it. The enterprise failed from want of patronage.*

Hoping to obtain better compensation for his toil, he settled in Baltimore about the close of 1812, taking with him his wife and their three boys. Some near kinsmen, who were engaged in trade, had been settled there sometime.

He seems to have been more prosperous in his new abode. At first he lived at Fell's Point, and had an apothecary shop, and subsequently in South Charles street. He was elected physician of the Hibernian Society in 1816. The same year it was charged that "Dr. P. K. Rogers, at Fell's Point, persists in the use of variolous matter in preference to vaccine, against the public remonstrance of Dr. James Smith."†

The controversy on this question, carried on in the newspapers, was detrimental to his professional business. His income was inadequate to his need; still, he worked on zealously. In 1819 his qualifications and capacity to teach were recognized. He was elected Professor of Natural Philosophy and Mathematics in the ancient College of William and Mary, founded at Williamsburg, Va., 1692, in place of Dr. Robert Hare, resigned.

Dr. Rogers was soon settled in the Brofferton house, on the college campus, with his wife and four boys. He was earnest in his work. He made all the apparatus required to illustrate his lectures. In this making and mending he was habitually aided by his sons, who thus acquired unusual facility in the use of tools for working wood and metals. He also prepared and printed a syllabus of his course of instruction.

During the summer of 1820, after the close of the session of the college, July 4, Mrs. Rogers was attacked with malarial fever and died, leaving the four boys, the youngest in his seventh and the eldest in his eighteenth year, to the care of their father. The boys became almost foster children in families of the professors.

To avoid the malarial fever always prevalent in the locality

* At this time the College of Physicians of Philadelphia has a library of 35,000, the Pennsylvania Hospital about 12,000, and the Medical Department of the University of Pennsylvania nearly as many, all accessible to the medical public.

† Medical Annals of Baltimore. By John R. Quinan, M.D. 8vo, pp. 274. Baltimore, 1884.

during summer, Dr. Rogers habitually left Williamsburg, as soon after July 4 as practicable, to pass the vacation. After the close of the college in 1828, he spent several days in Baltimore and then went to Ellicott's Mills. A few days later he was seriously ill. All his children came to his bedside. He died of malarial fever, August 1st, 1828, in the fifty-second year of his age.

This sketch of his trying career is presented because the profound, affectionate respect with which the sons always regarded their father, suggests that this commemoration would be unsatisfactory to them in their graves if he were not associated in it. Besides, he seems to have been the mental type of his sons to a considerable degree, though they were indebted to their mother largely for their moral constitution.

Of their seven children four sons survived them.

The eldest, James Blythe Rogers, was born in Philadelphia, February 11, 1802.* His preliminary education was acquired in Baltimore and Williamsburg, Va., at the College of William and Mary (1820–21). He studied medicine in the office of Dr. Thomas E. Bond, and in 1822 received the degree of Doctor of Medicine from the University of Maryland. Epilepsy was the subject of his thesis. There is a tradition that while he was a student he assisted his brothers, William and Henry, in teaching a school. After graduation, to eke out his too scant income, he taught a class of girls, in conjunction with a Dr. McClellan who had a school for boys in Baltimore. This connection proved to be unsatisfactory and the enterprise was given up. He was needing employment, and thought of seeking the post of surgeon to a colony of free negroes which it was proposed to establish at Cape Mesurado and consulted his father on the subject. He wrote in reply—"What is the use of your complaining of mankind? The world as yet owes you nothing. Up to this time you have been simply a recipient of its benefits. Make yourself worthy of a place *here*, and you will find one." The project of going to Africa was abandoned.

He had formed an intimate friendship with a fellow-student and graduate, Dr. Henry Webster. They became partners to practise medicine at Little Britain, in Lancaster county, Pa., about two miles from the Maryland line.

* His parents then lived at No. 55 Lombard street.

The experience of a few years satisfied him that the career of a practitioner of medicine was uncongenial, repugnant to the sensitiveness of his nature and mental habits. He returned to Baltimore, and was soon appointed superintendent of an extensive manufactory of chemicals. Here he sedulously cultivated scientific and applied chemistry.

While thus employed he accepted, but after some hesitation based on a notion that he lacked fluency of speech, a quality for which he was subsequently distinguished, the professorship of chemistry in the Washington Medical College, of Baltimore. The position was not remunerative. During the same period he lectured on chemistry before the Mechanics' Institute, which was designed for the encouragement of the mechanic arts in imitation of the Franklin Institute of the State of Pennsylvania, and was also occupied in original investigations.

In September, 1830, at the age of twenty-eight, he married Rachel Smith, of Baltimore, who was a birth-right member of the Society of Friends.

During the winter of 1831–32 he lectured twice a week on natural philosophy and chemistry in Baltimore.

When the Medical Department of the Cincinnati College was established in 1835, he was appointed professor of chemistry, and filled the office until the establishment was closed in 1839. The summer vacations of these four years were spent in field work and chemical investigations in connection with the Geological Survey of Virginia, as an assistant of his brother William, who was the State Geologist.

While in Cincinnati he declined the office of melter and refiner in the branch Mint at New Orleans, offered to him by the President of the United States.

He became a permanent resident of Philadelphia in 1840, and in August of the same year he was elected a member of the Franklin Institute. His brother Henry, then Geologist of Pennsylvania, engaged him as an assistant in field and laboratory work. During seasons of leisure he delivered lectures to classes of medical students and examined them. He was appointed lecturer on chemistry, 1841, in the Philadelphia Medical Institute, then a flourishing summer school, founded by Dr. Nathaniel Chapman. August 21, 1844, he was unanimously elected Pro-

fessor of General Chemistry in the Franklin Institute, and received a vote of thanks for his services when he resigned, October 20, 1847. In conjunction with his brother Robert, he compiled from the works of Dr. Edward Turner and Dr. William Gregory, a volume on inorganic and organic chemistry, designed to be a text-book which was published in 1846. These many occupations yielded him a modest income.

In April, 1846, he was chosen a member of the American Philosophical Society.

In 1847, in the forty-sixth year of his age, he succeeded Dr. Robert Hare as Professor of Chemistry in the University of Pennsylvania. He was a representative of the Franklin Medical College (in which he was at the time Professor of Chemistry), in the National Medical Convention, assembled in Philadelphia, May 5, 1847. This convention then became the American Medical Association, which is still prosperous.

In October of the same year, he was elected a member of the Academy of Natural Sciences of Philadelphia. He was one of the representatives of the University of Pennsylvania in the National Convention for the revision of the Pharmacopœia of the United States, in 1850.

He was never robust. His frame was light and elastic. In latter years his constitution was considered to be delicate. At times he suffered from nervous exhaustion and defective nutrition, ascribable to long and incessant labor. An attack of albuminuria closed his life, June 15, 1852, in the fifty-first year of his age. He left his widow, who died in 1882, with their two sons and a daughter.

He was an eminently efficient, interesting and popular teacher. "Disinterested and generous in his relations with the world, mild and conciliating in deportment, open and affable when approached, urbane to every one, his virtues shone conspicuously within the circle of his friends."*

William Barton Rogers, the second child of his parents, was born in Philadelphia, December 7, 1804.†

*A memoir of the Life and Character of James B. Rogers, M.D., Professor of Chemistry in the University of Pennsylvania. By Joseph Carson, M.D., Professor of Materia Medica and Pharmacy in the University of Pennsylvania. Delivered by request of the Faculty, October 11th, 1852, and published by the Class.

†They resided at the time at No. 262 North Second street, probably between Vine and Callowhill streets.

The middle name is a loving memorial record of his father's respect and friendship for his medical preceptor, Dr. Benjamin Smith Barton.

William B. Rogers obtained his early education in Baltimore and Williamsburg, Va., at the College of William and Mary, of which he was an alumnus 1820–21.

For a time, while a youth, he was employed in Baltimore by a dealer in crockeryware, and acquired such facility in wrapping packages that he subsequently reckoned it among his accomplishments.

About 1821, in conjunction with his brother Henry, he set up a school in the suburbs of Baltimore. How long, or with what degree of success they taught, has not been ascertained.

In 1827, then in his twenty-third year, he delivered a course of lectures on natural science before the Mechanics Institute.

In 1828 he was appointed Professor of Natural Philosophy and Mathematics in the College of William and Mary, to fill a vacancy caused by the death of his father.

His attention was directed to natural science, and especially to geology. In 1830 he contributed to the Messenger of Useful Knowledge, edited by his brother Henry, then a professor in Dickinson College, Carlisle, Pa., articles on Dew. He was elected a correspondent of the Academy of Natural Sciences of Philadelphia in 1833. In June, 1834, and May, 1835, he published in the Farmers' Register three papers on the Green Sand of Virginia.*

About this period he was allowed to advocate before the Legislature the institution of a geological survey of the State of Virginia. March 6, 1835, an act was passed directing "the Board of Public Works to appoint a suitable person to make a geological reconnoissance of the State," provided his compensation shall not exceed $1500.

To him 1835 was an eventful year. He was appointed Professor of Natural Philosophy and Geology in the University of Virginia; chosen a member of the American Philosophical Society July 17, and Director of the Geological Survey of Virginia.

*Contained in a Reprint of the Annual Reports and other papers on the Geology of the Virginias. By the late William Barton Rogers, LL.D., &c., Director of the Geological Survey of Virginia from 1835 to 1841, President of the National Academy of Sciences. 12mo, pp. 832. D. Appleton & Co., New York, 1884.

His report of the geological reconnoissance was presented January, 1836. A note on the fertilizing efficacy of marl, taken from the report of Henry D. Rogers on the Geology of New Jersey, and a plan of the proposed Geological Survey of Virginia are appended to it. Reports of the progress of the survey were made annually from 1836 to 1841. It was discontinued in 1842. All his brothers were among his assistants in field and laboratory work.

He, as well as his brothers Henry and Robert, participated in the organization of the Association of American Geologists and Naturalists in 1840, and presided at the meetings of 1845 and 1847. At the latter it was changed to the American Association for the Advancement of Science.

At the meeting held in Boston, in 1842, he presented, in connection with his brother Henry, a paper on The Laws of Structure of the more Disturbed Zones of the Earth's Crust, embracing what is called the wave theory of mountain chains. This theory was a result of an extensive study of the Appalachian chain in Pennsylvania and Virginia, and was supported by reference to many geological sections and facts. They were first to assert that the structure of mountain chains everywhere is the same in all essential features, an assertion which has been confirmed by the observations of Murchison in the Ural mountains, and by Darwin in the Andes.

The meeting was memorable. Dr. Samuel George Morton presided. Among the distinguished naturalists present were the elder Silliman, Professor Hitchcock, Dr. Charles T. Jackson, the French astronomer, Nicollet, Sir Charles Lyell, and the palæontologist, Hall. Several able and elaborate essays were read and discussed, but the prominent feature of the meeting was the Rogers paper, which was delivered as an oral statement. William B. Rogers first described the physical structure of the mountain chain extending 1500 miles, from Vermont to Alabama, and then Henry D. Rogers followed, explaining the phenomena and expounding the hypothesis deduced from them.

John L. Hays, of Cambridge, Mass., who was present, says, June 1, 1882: "I have frequently read it [the paper] since. To me it is now comparatively tame in expression. It lacks the inspiration of the scene and the man, the illustrative diagrams,

the emphasis of voice and finger pointing out the distinguishing phenomena, and the fervor of spontaneous utterance. The impression I have of this exposition as delivered is, that next to the Phi Beta Kappa oration of Wendell Phillips at Harvard, it is the most lucid and elegant effort of oral statement to which I ever listened. It may be true that eloquence is but a secondary quality in the philosopher; but in respect to the matter of this memoir and the general researches and deductions of the brothers Rogers here named, in their peculiar field of exploration, it may be safely asserted that they have made the most original and brilliant generalizations recorded in the annals of American geology, and have thrown light on the structure of mountain chains generally, which entitles them to a place by the side of the great expositor of this subject, Eli de Beaumont, of France."

"The wave theory of mountain chains was the first important contribution to the dynamical and structural geology which had been brought forward in this country. It excited at the time great interest, as well from the novelty of the views as from the eloquence with which they were set forth; and to-day it is still regarded as one of the most important advances in orographic geology."*

William B. Rogers was elected an honorary member of the Boston Society of Natural History, June 1, 1842, and a fellow of the Academy of Arts and Sciences, 1845, of which he was Corresponding Secretary from 1863 till 1869.

In 1844–45 he was Chairman of the Faculty of the University of Virginia.†

June 20, 1849, he married Miss Emma, daughter of the Hon. James Savage, of Boston, and with his bride sailed the same day. They visited England and Scotland, passed some days in Paris, a few weeks in Switzerland, and returned in October, when he resumed his vocation at the University of Virginia. Mrs. Rogers became "the promoter of his labors, the ornament and solace of his middle life, and the devoted companion and support of his declining years."‡ Recently she has edited, very

* Josiah Parsons Cooke. Notice of William Barton Rogers, Founder of the Massachusetts Institute of Technology. Proceedings of the American Academy of Arts and Sciences, vol. xviii, p. 428–438.

† A Sketch of the History of the University of Virginia. Charlottesville, Va., 1880.

‡ An address delivered before the Society of the Alumni of the University of Virginia, on Commencement day, June 27, 1883. By William Cabell Rives.

admirably, a reprint of his annual reports and other papers on the geology of the Virginias.

In 1853 he resigned from the University of Virginia, after eighteen years of efficient service, and transferred his domicile to Boston. During the earlier years of his residence here he delivered two or more courses of Lowell lectures, and contributed to the attractions of the Thursday Evening Scientific Club, of which he was president several years.

He was present at a meeting of the British Association in Dublin, 1857, and early in 1859 he began the foundation of the Massachusetts Institute of Technology, which was incorporated in 1862, chiefly through his exertions and influence. He was elected president of it, April 8, 1862. Impaired health caused him to resign the office in the autumn of 1868. He was induced to accept it again in 1878, but infirmity compelled him to relinquish the post in 1881.

He was appointed inspector of gas and gas meters for the State of Massachusetts, in 1861, and, accompanied by Mrs. Rogers, he went to Europe in 1864, to collect models of machinery and apparatus for the use of the Institute of Technology. At the meeting of the British Association for that year, he presented a paper entitled An account of apparatus and processes for chemical and photometrical testing of illuminating gas.

News of the serious illness of his brother Henry, then Regius Professor of the Natural Sciences in the University of Glasgow, hurried him and Dr. Robert E. to Europe in 1866, but his brother died before their arrival. On this sad errand they were absent only a few weeks.

In 1867 he was appointed Commissioner to represent the State of Massachusetts at the Paris Exhibition, and during the summer visited it almost daily.

The Harvard University, Cambridge, Mass., conferred upon him, in 1866, the honorary degree of LL.D., and he was elected President of the National Academy of Science to succeed Joseph Henry, who died May 13th, 1878.

At the meeting of the American Association for the Advancement of Science, at Buffalo, N. Y., in 1876, he was elected President; but he was unable to be present at the meeting of 1877. "Had I been able," he wrote from Newport, August 22, to the

permanent Secretary, "to write the address for which I was preparing early in the summer, I should have taken the risk of presenting myself at Nashville, though only for a day or two. But the nerve-exhaustion to which I have for many years been liable, aggravated by the season, compelled me soon to suspend and finally give up the work."*

In 1875–6 he assisted in establishing at the University of Virginia, a Museum of Natural History, and in 1876–7 contributed a thousand dollars to the fund of the institution.†

At the Commencement of the Massachusetts Institute of Technology, May 30, 1882, while delivering an address, he bent forward on the table before him as if to consult notes, then slowly regaining an erect position, he threw up his hands. His life had ended. The last sentence he uttered was, "I remember, that one hundred and fifty years ago Stephen Hales published a pamphlet on the subject of illuminating gas, in which he stated that his researches had demonstrated that 128 grains of bituminous coal ———"

Thus was closed, probably without pain, his bright career. He had fairly won and received all the compliments and honors that a votary of science in this country can win; and he was universally esteemed in private life on account of his probity, urbanity and social accomplishments.

Henry Darwin Rogers, the third son and fourth child, was born in Philadelphia, August 1, 1808.‡

The name Darwin was given to him by his father in token of his admiration of the poetical works of Erasmus Darwin, particularly of his Botanic Garden, long passages from which he was often pleased to repeat for the entertainment of the family.

He was educated in Baltimore and Williamsburg, Va.

In his twenty-second year, January, 1830, he was elected Professor of Chemistry and Natural Philosophy in Dickinson College, Carlisle, Pa. "Whilst connected with the College he edited The Messenger of Useful Knowledge, a monthly magazine of scientific character, and also containing essays on educa-

*Proc. Amer. Assoc. for the Advanc. Sc., xxvi, p. 373. 1877.

†See A Sketch of the University of Virginia. Richmond, Va., 1885.

‡His parents lived at No. 205 Mulberry, now Arch street, in 1807 and 1808; and at No. 13 S. Ninth street, in 1810, 1811 and 1812—see City Directory.

tional, literary and political subjects, and valuable information from foreign journals."*

His brother William contributed to it a series of short articles to explain the formation of dew.

When the editor resigned his professorship in the college at the end of the year, the publication of the magazine ceased.

He accompanied R. Dale Owen to England, in 1831, and enrolled himself a student of chemistry in the laboratory of Dr. Edward Turner, and attended the lectures of De la Beche, on geology, and of other teachers of science in London. He returned to Philadelphia in the summer of 1833. The liberal assistance of his brother William placed the opportunity of this course of study in Europe within his reach.

In the winter of 1833–34 he delivered a course of lectures on geology, in the hall of the Franklin Institute, of which he became a member on the nomination of his friend Alexander Dallas Bache, in January, 1834. From January, 1838, till December, 1843, he was a member of the Board of Managers and served on several standing committees. His resignation from the Institute was accepted March 16, 1848.

The University of Pennsylvania conferred upon him the degree of Master of Arts in 1834, and elected him Professor of Geology and Mineralogy the next year. From 1835 until 1846, when he resigned, he gave instruction on the subject, and published "A Guide to a Course of Lectures on Geology, delivered in the University of Pennsylvania." 8vo, pp. 43.

In his twenty-seventh year he was chosen, January 2, 1835, a member of the American Philosophical Society,† and in November he was elected a member of the Academy of Natural Sciences of Philadelphia, and served on its Publication Committee from December, 1835, to December, 1836.

The Legislature of the State appointed him, April 24, 1835, to make a geological and mineralogical survey of New Jersey. His first report (8vo, pp. 175) was made February 12, 1836,

* A sketch of Dickinson College, Carlisle, Penna., including the list of Trustees and Faculty from the foundation, and a more particular account of the Scientific Department. By Charles F. Himes, Ph.D., Professor of Natural Science. Illustrated by engravings and by photographs executed in the laboratory. 12mo, pp. 153. Lane S. Hart, Harrisburg, 1879.

† During 1836-37 he was frequently at the meetings and served on several special committees.

and his final report (8vo, pp. 301, with 2 maps) was presented in 1840.

Chiefly on the recommendation of the Geological Society of Pennsylvania, which was founded in Philadelphia, April, 1832, and ceased in 1836, the Legislature determined, March 29, 1836, to have made a geological survey of the State of Pennsylvania.

The survey was immediately organized. Henry D. Rogers was appointed geologist, James C. Booth and John F. Frazer assistant geologists, and Robert E. Rogers chemist.

Henry D. Rogers was elected an honorary member of the Boston Society of Natural History, June 1, 1842. He participated in discussions at its meetings every year from 1845 to 1858, both inclusive, except the year 1856. All his oral communications relate to geological facts or theories.

In 1844 he delivered a course of lectures on geology in the Masonic Temple in Boston.

He became a resident of Boston in 1846, and was married there in March, 1854, to Miss Eliza S. Lincoln.

He made six annual reports of the progress of the Geological Survey of Pennsylvania; the first December 20, 1836, and the last February 1, 1842. The Legislature of 1841–42 failed to make an appropriation for the continuance of the survey, and it was therefore suspended. Professor Rogers was employed from 1841 till 1851 by coal companies as an expert.

Field-work of the survey was resumed in 1851, and continued through 1852, '53 and '54.

Appropriations made by the Legislature for carrying on the survey were always too narrowly restricted, never liberal. Hence obstacles to the progress of the work intervened and delayed its completion.

Under an act of March, 1855, it was agreed that the publication of the final report of the survey should be confided to Professor Rogers. He was to own the copyright and receive $16,000, on condition that he delivered to the State, within three years, one thousand copies of it. In order to produce the report in an appropriate style for this sum, it was obvious to him that the work must be done where the skilled labor requisite for it could be obtained at rates below those prevailing at the time in Philadelphia. For the sake of such advantage he transferred

his domicile to Edinburgh, where the printing of the report and the engravings to illustrate it were executed. This great work was published according to contract, bearing the imprint of J. B. Lippincott & Co., Philadelphia, 1858.

It brought him a harvest of approbation from the scientific community, but no other profit. The cost of the publication exceeded the sum stipulated for it by several thousand dollars. The results of assiduous labor during eighteen years, often embarrassed by anxiety in surmounting difficulties, are admirably presented in this magnificent report.

It consists of two quarto volumes, which together contain 1682 pages, illustrated by 778 intercalated cuts, 69 plates and 18 folded sheets of sections, all executed in the best style of that time. A summary history of the survey, and the names of all the assistants employed in it from beginning to end, are given in the preface, with praise of most of them and grateful mention of assistance in the work from his brother William.

The chief of the Second Geological Survey of Pennsylvania, Professor J. P. Lesley, a qualified judge, commends the work generally, a summary of the contents of which he gives, and says: "But let any one read the special memoirs with which he closes the second volume of his final report, and there can be no sentiment but one of admiration for the breadth of his views and the clearness, force and elegance of his delineations. No geological paper has ever appeared excelling in every good quality his memoir on coal."*

While resident in Edinburgh the University of Dublin conferred upon him, in 1857, the honorary degree of Doctor of Laws; he was elected member of the Geological Society of London, and a fellow of the Royal Society of Edinburgh; became one of the conductors of the Edinburgh New Philosophical Journal, and joined Sir William and A. K. Johnston in the publication of maps of physical geography and geology. In 1858 he was appointed Regius Professor of Natural History in the University of Glasgow. Then he transferred his residence to Shawlands, a suburb of that city. During the last two years of

*Second Geological Survey of Pennsylvania, 1874-5-6. Historical Sketch of Geological Explorations in Pennsylvania and other States. By J. P. Lesley. Published by the Board of Commissioners for the Second Geological Survey. Harrisburg, 1876.

his life he was President of the Philosophical Society of Glasgow.

Accompanied by his wife and daughter he visited the United States in August, 1865, and returned without them to Shawlands early in April, 1866, to be in time to begin his courses of instruction in May.

His physical constitution was not vigorous. His force had been slowly waning for some time. Indeed, hope of restoration to health was among the motives of his voyage to the United States. On returning to his residence, No. 5 Elgin Villas, he tried to resume his duties, but found his power to labor had been so far expended that he could not work. An obscure disease, which probably had been long seated in the brain, terminated his life May 29, 1866, near the close of his fifty-eighth year. The announcement of his death in the newspapers of Glasgow was accompanied by expressions of praise of his character and approbation of his career, mentioning the honors paid to him by learned organizations. "He was," said one, "a quiet, amiable, and thoroughly lovable man, and much admired by all who had the opportunity of knowing him intimately." Another said, among other things, "indeed he actually shone when descanting on the physical conformation of the earth's surface, and the grandeur of the operating forces to produce that conformation. His public lectures were well worth hearing when he confined himself to geology and the allied subjects of climatology and physical geography, and his services thus came to be in requisition in many places beyond the college class-room. He had keen powers of observation, and his power of generalization reached very high. He was likewise possessed of great literary ability, and frequently contributed excellent articles to scientific and other journals."

The career of the youngest and last of these distinguished brothers was as useful and praiseworthy as that of his seniors.

Robert Empie Rogers, the sixth child and fourth son of his parents, was born in Baltimore, March 29, 1813.

He assumed the name of Empie while a youth as a lasting token of his grateful appreciation of parental care bestowed upon him at the College of William and Mary after the death of his mother, in 1820, when he was only seven years old, by the Rev. Adam P. Empie, D.D., and his wife.

His early education was directed by his father. After his death, 1828, it was managed by his brothers James and William.

The intention was that he should be a civil engineer. He started as an assistant to a party making the survey of the route for the Boston and Providence Railroad. When and how long he was so employed is uncertain. His experience, however, was not satisfactory. In a letter, dated New York, May 6, 1833, and addressed to his brother William, at Williamsburg, Va., he says: "Henry asks what are my plans, and broaches the idea of my again embarking for a time in engineering. For me at least—for *me alone*—I fear there is little prospect of success, at any rate in connection with those with whom I have been previously engaged. I do not know how it might be elsewhere.

"In a letter to Henry, some time since, I stated, as I have before done to you, that my favorite desire always has been, and I thought always would be, to follow, if possible, in your career, to become an instructor; and as preparatory to some higher station, I thought I should like to have charge of a school, either of my own or become teacher in some flourishing establishment of the kind. Such an occupation I think would be a useful schooling for myself, for I conceive that at no time could I learn so fast as when teaching, for then I should be making practical application of what I would be myself acquiring, and while occupied I would have also a portion of time altogether apart to myself to devote in my own way to my own improvement. * * * * * *

"Your advice about my studies I think correct. I was doubtful whether it would be prudent to occupy myself with mathematics until I could be under your direction. I will therefore refrain for the present and continue with botany, geology and mineralogy."

These few sentences distinctly imply the character of his mental tone at that period, as well as the scope of his young ambition, and at the same time suggest that his conduct was swayed and moulded by the opinions and example of his brother William.

The project of becoming a civil engineer was abandoned. Probably in the autumn of 1833 he determined to study medicine. He became a pupil of Dr. Robert Hare, Professor of

Chemistry, and worked zealously in his laboratory till the close of his under-graduate course.

He duly submitted a thesis, entitled "Experiments on the blood, together with some new facts in regard to animal and vegetable structures, illustrative of many of the most important phenomena of organic life," etc., and graduated from the Medical Department of the University of Pennsylvania, March, 1836 This thesis, illustrated by many wood cuts, was published in the American Journal of the Medical Sciences.*

The practice of medicine was not to his taste. He devoted himself to chemistry. From 1836 to 1842 he was the chemist of the first Geological Survey of Pennsylvania, of which his brother Henry was the chief.

He became a member of the Academy of Natural Sciences, of Philadelphia, February, 1837. During nearly a half century he evinced interest in the pursuits of the Society. At irregular intervals he was frequently present at its stated meetings of several successive years, participated in discussions, delivered lectures to promote its interest and contributed to its funds. †

Dr. Rogers was elected a member of the Franklin Institute of the State of Pennsylvania, April 18, 1838, and resigned May 18, 1845. He was again elected November 18, 1852, on returning to Philadelphia after several years' absence; became a "life member" in 1855, and one of the Board of Managers in 1857. He was one of the vice-presidents during seventeen years, from January, 1858. In January, 1875, he was elected President. He declined reëlection January, 1879,‡ and was again returned to the Board of Managers, and continued to be a member of it to the close of his life.

* Vol. xviii, 1836.

† In the Proc. Acad. Nat. Sc. Philadelphia, from 1859 to 1862, many of his verbal communications are noted.

‡ On vacating the chair for his successor, at the stated meeting, January 15, 1879, he thanked the members of the Institute for their unvarying kindness towards him during the four years of his presidency. And then, on motion of Mr. J. E. Mitchell, the meeting unanimously adopted the following preamble and resolution:

"WHEREAS, our highly esteemed presiding officer, Dr. R. E. Rogers, having declined a re-election to the office he has so acceptably filled for the past four years, it is therefore,

Resolved, That in parting with Dr. Rogers we desire to place on record our high appreciation of the courteous and impartial manner with which he has presided over our deliberations, as well as our appreciation of the valuable time

He was prominently active in the work of the Institute, delivered courses of lectures on chemistry before its classes, assisted in the management of its public exhibitions, served on several of its standing and on many of its special committees, the most notable of which was one on tests of the efficiency of dynamo-electric machines,* and another on the dangers of electric lighting.†

At the celebration of the semi-centennial anniversary of the foundation of the society, February 5, 1874, in the Musical Fund Hall, he delivered an eloquent address, narrating in a general way a history of scientific discoveries and their practical applications in the half century, and indicating how the work carried on during that period by the Institute had contributed to the progress of science and the diffusion of knowledge.‡

Near the close of his thirtieth year he married, March 13, 1843, Miss Fanny Montgomery, a daughter of Mr. Joseph S. Lewis, a gentleman who was prominent among those who established the city's water-works at Fairmount.

In the session 1841–42, on invitation, he completed the course of chemical instruction at the University of Virginia which had been interrupted by sickness of the professor, Dr. John P. Emmet, from which he did not recover. Dr. Rogers was elected in his place, Professor of General and Applied Chemistry and Materia Medica, in March, 1842, and discharged the duties of the office satisfactorily to all concerned during ten years. In May, 1852, he was a representative of the University of Virginia at the meeting of the American Medical Association in Richmond,

* Journal of the Franklin Institute, p. 1878, lxxv, pp. 303–378.

† Journal of the Franklin Institute, 1881, lxxxii, pp. 401–408.

‡ Commemorative Exercises at the Fiftieth Anniversary of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts. Held on Friday evening, February 6, 1874, at the Musical Fund Hall. Hall of the Institute, Seventh street, below Market street, Philadelphia, 1874. 8vo, pp. 96.

---

and talents he has devoted to the service of this Institute, and we indulge the hope that in future as in the past, it may have the benefit of his extensive research and great experience"

At the stated meeting, September 7, 1881, the President announced the death of Prof. Robert E. Rogers, and that the Board of Managers had appointed Messrs. J. E. Mitchell, E. J. Houston and Isaac Norris, Jr., a committee to suitably express the sentiments of the Board; and, on motion, appointed Dr. G. M. Ward and Dr. W. H. Wahl, to co-operate with the committee. Their report is published in the Journal, p. 387, lxxxviii, 1884.

Va., and so became a permanent member of the society. At its meeting in New York, 1853, he represented the University of Pennsylvania. He was present when the Association met at Philadelphia, in 1855, and again as a representative of the University of Pennsylvania in 1872. At that meeting, in behalf of the profession of Philadelphia, he welcomed the delegates.*

He was elected Professor of Chemistry in the University of Pennsylvania, August, 1852, in place of his brother James, deceased, and Dean of the Medical Faculty in 1856.

The American edition of Lehmann's great work, Physiological Chemistry, was edited by him and published by Blanchard & Lea, October, 1855.†

He was chosen a member of the American Philosophical Society July 30, 1855, and elected one of its Council January 7, 1859. He was frequently present at the meetings of the Society, often took part in discussions, and served on several committees.

He was elected a Fellow of the College of Physicians of Philadelphia April 1, 1857, but was rarely present at its meetings. At one of them, 1858, he related a case of arsenical poisoning in which he appeared in Court as an expert. The victim had been taking, for some time, subnitrate of bismuth by prescription. He found that a remnant of the same contained a small quantity of arsenic, and also that samples of subnitrate of bismuth, obtained from ten druggists' shops, were contaminated in like manner, but not sufficiently to render the quantity ordinarily prescribed dangerous. On this testimony the jury acquitted the accused, although circumstances strongly implied his guilt.‡ Arsenical contamination of the subnitrate of bismuth of the shops had not been previously suspected.

While the war of rebellion was in progress Dr. Rogers was appointed an Acting Assistant-Surgeon in the army, July 8,

* Trans. Amer. Med. Assoc., pp. 9-11, xxiii, 1872.

† Physiological Chemistry. By Professor C. G. Lehmann. Translated from the second edition. By George E. Day, M.D., F.R.S., Fellow of the Royal College of Physicians, and Professor of Medicine in the University of St. Andrews. Edited by R. E. Rogers, M.D., Professor of Chemistry in the Medical Department of the University of Pennsylvania. With illustrations, selected from Funke's Atlas of Physiological Chemistry, and an Appendix of Plates. Complete in two volumes. [8vo, vol. 1, pp. 648, vol. 2, pp. 547.] Blanchard & Lea, Philadelphia, 1855.

‡ Amer. Jour. Med. Sc., p. 99, vol. xxxvi, 1858.

1862, for duty at the West Philadelphia Military Hospital, and served till June 18, 1863. At his suggestion and under his supervision, a steam mangle was set up in West Philadelphia—Chestnut street, east of Thirty-first street—to accelerate the laundry work of the great hospital. The day the machine was ready to be set to work, January 10, 1863, he was present to see it started. It is related that while benevolently showing a woman who was to feed it the dangers to which the work exposed her, his own right hand was caught and crushed betwixt the very hot [180° F.] revolving iron cylinders. With characteristic alertness he reached out his left hand and instantly threw the leather band off from the revolving drum which gave motion to the machine, and stopped it. Then, in lifting the heavy cylinder [800 pounds] for his release, it slipped from the end of a crowbar in the hands of a workman and fell back upon the hand, thus aggravating the injury already inflicted.

In his suffering he was considerate of another. He conjectured that his wife might be too profoundly shocked, should he appear before her with the hurt hand concealed in bloody wraps, immediately after the sound of rattling wheels in their quiet street had ceased in front of the house. To convey to her an impression that his injury was less than it really was, he gallantly alighted from the carriage in which he was at the street corner nearest his residence and walked home.

His colleague in the University, Dr. Henry H. Smith, Professor of Surgery, amputated the injured extremity above the wrist at night, January 24. The result of the operation was entirely satisfactory. For some time he wore an artificial hand, admirably made for him by C. W. Kolbè, a well-known cutler of the city.

One day, very soon after the stump had healed, as Professor Smith was about to begin his lecture, Dr. Rogers entered the arena and begged leave to interrupt him for a moment. Then, resting his left hand upon the Professor's shoulder, he addressed the assembled class in his eloquent way, and expressed his grateful sense of obligation to the eminent skill and kind attention of their Professor of Surgery. His speech was received with rounds of tremendous applause. The scene is not likely to be forgotton by any who was present.

Almost ambidextrous, prior to the accident, he speedily learned

to write with his left hand and to use the right arm, beneath the shoulder, in prehension with notable skill in his experiments while lecturing.

Soon after the loss of his hand a greater sorrow came to him. His happy married life of twenty years was ended. His wife died February 21, 1863.

Under an attraction of speculative chances in petroleum, which at the time shrewd men believed to be excellent, many friends, relying upon his scientific judgment in the premises, were induced to join Dr. Rogers in organizing the Humboldt Oil Company, February 17, 1864. They contributed a quarter of a million of dollars. Land supposed to be richly stored with oil was purchased, wells were sunk and work carried on for some time without profit. The assets of the company were publicly sold, February 4, 1873, for a sum not more than sufficient to return the stockholders one cent a share. Dr. Rogers owned one-fifth of all the shares, and lost more than any one who had stock in the unhappy enterprise he had prompted.

Miss Delia Saunders became his second wife, April 30, 1866.

May 10, 1872, the Secretary of the Treasury of the United States appointed Drs. H. R. Linderman and Robert E. Rogers a committee to examine the Melter and Refiner's Department of the Mint at Philadelphia, and ascertain the extent and sources of an alleged "waste of silver in excess of the amount tolerated by law." The processes of assaying and refining the bullion and converting it into coin were carefully investigated and tested by numerous experiments at the Mint, and at the Assay Office in New York. About two months were spent in the examination. The result of it was presented July 25, 1872, in a well considered and elaborate "Report on the wastage of silver bullion in the Melter and Refiner's Department of the Mint."

This investigation, valuable in itself, was also valuable in its consequences. His experimental trials to apply the principles of chemical science to the improvement of an industrial process of great importance, suggested modifications in the methods of refining the precious metals which were subsequently adopted.*

* "Some important questions of a chemical and metallurgical character having arisen with regard to various mint manipulations of the precious metals, a series of experiments to determine the same were made at the Philadelphia Mint, in the latter part of the fiscal year, under the supervision of Professor R. E. Rogers. The results obtained were conclusive of several points, and will be of value in future minting operations." Report of the Director of the Mint, November 1, 1873, p. 12.

PROC. AMER. PHILOS. SOC. XXIII. 121. Q. PRINTED NOVEMBER 11, 1885.

He visited the Mint at San Francisco, in 1873, departing from Philadelphia August 5, and returning September 20, carefully studied its working, and submitted reports upon it to the Director of the Mint in October and December.

September 4, 1874, he reported the successful result of his experiments made at the Assay Office in New York, in August, to rid the establishment of inconvenience from acid vapors. Prior to that time nitrous acid fumes, arising from the nitric acid used in refining silver, were allowed to escape, through the chimney, into the open air, sometimes seriously annoying neighbors. To correct the evil, Dr. Rogers had constructed in the attic of the building a furnace for burning coke, into which the fumes were conveyed and burned. Instead of extinguishing the fuel these fumes promote its combustion, which is an interesting chemical fact.

He visited Washington by request in January and March, 1875, to confer with the authorities about plans which he had proposed for the equipment of a refinery in the Mint at San Francisco. Those plans, which included the sulphuric acid process recommended by him October 15, 1873, were adopted May 3, 1875. They included the erection of additional buildings.

He arrived at San Francisco May 19. The actual work of construction and equipment of the refinery was begun May 24, and finished July 26, and placed in charge of the Superintendent, in working order, August 25, 1875.

At the suggestion of Dr. Rogers, during the progress of the work, an artesian well was sunk within the hollow square of the Mint which supplies 100,000 gallons of excellent water daily for all the uses of the establishment.

In reference to this enterprise, the Director of the Mint, in his annual report, November 20, 1875, says: "The arranging of the plan of the refinery and its equipment was intrusted to Robert E. Rogers, Professor of Chemistry in the University of Pennsylvania, whose eminent qualifications as a chemist and metallurgist, rendered him peculiarly qualified for this service, and who performed the duty assigned him in an entirely satisfactory manner. The refinery has been in successful operation since the 26th day of August last, and with much advantage to the public interests."

Under instructions of the Director of the Mint he made, in November, 1875, "a careful and laborious investigation" of the consolidated Virginia and California Mine in Nevada, for the purpose of estimating "their probable total yield of gold and silver based upon their present explored extent and the quality of their ores as ascertained by assays." And after due consideration of the chances of over-estimation he places the production "at not less than $150,000,000," which is one-half of the sum indicated by the assays.

Besides doing the work just mentioned, Dr. Rogers served as a member of the Annual Assay Commission every year from 1874 to 1879, both years included.

From June, 1872, till his death, he was one of the chemists, employed by the Gas Trust of Philadelphia, to make analyses and daily photometrical tests of the gas. He was succeeded in the office by his assistant, Dr. George M. Ward.

Very soon after the University of Pennsylvania was transferred to the buildings which it now occupies in West Philadelphia, it was suggested that the scheme of medical teaching which had been long followed ought to be improved. During the evolution of the plan adopted and the transition from the old to the new ways, personal discussions of the subject were frequent and often warm. The Board of Trustees, it was supposed, did not rightly appreciate the injury which the proposed changes might work to its medical faculty. The professors were ready for and in favor of such reform as would make the diploma significant of qualifications higher than obtainable in any other medical school; but they were not prepared to sacrifice their pecuniary interests to effect at once what might be achieved gradually without much loss. The Trustees seemed to differ from them more about the time and methods of proceeding than the object desired.

With comparatively few exceptions, medical education is sought as a means of livelihood where it may be had at least cost of labor, time and money. The diploma, which carries with it license to practise, the public generally accepts as a certificate of qualification. Rivalry and competition of the many medical schools are strong, each striving to attract as many students as possible, because, as a rule, the emolument of the

professors is contingent upon the number; and large classes, in common estimation, vouch for the excellence of the school as well as of the qualification of its graduates.

The circumstances of medical teaching suggested that to immediately prolong the course of study, thus augmenting the expenses of the student and increase the requirements of graduation to what they should be, must be instantly followed by great reduction of the classes, and consequently of the remuneration of the professors.

The aspect of affairs was to them unpromising. Discontent was prevalent.

While matters were still in an uncertain state, Dr. Rogers, without application, was elected, May 2, 1877, Professor of Medical Chemistry and Toxicology in the Jefferson Medical College, a chair just vacated by resignation. He accepted the office and resigned his position in the University, which he had held during a quarter of a century. The transfer added to his emolument without increase of labor and relieved his anxiety. It was understood that several of his old colleagues expressed at that time willingness to accept position elsewhere under like conditions.

The Trustees managed affairs wisely. They established the excellent scheme of medical education now in operation, which, followed thoroughly by the student, places him beyond the necessity of seeking further instruction after graduation in post-graduate courses, which many to whom diplomas may have been prematurely granted consider essential to properly qualify them for general practice. Discontent has disappeared. The professors receive annual salaries in place of fees from students. The prosperity of the Medical Department of the University seems to be assured.

The reception of Dr. Rogers into the Jefferson Medical College was cordially manifested at his lecture introductory to the course of 1877–78. It was estimated that not less than 1200 physicians, students and others were crowded into the hall. At the conclusion of the lecture a silver vase was presented to him as a token of the respect felt for him by the great class of medical students.

In addition to his own work in the college he completed the course of instruction on Materia Medica in the session of 1878,

left unfinished by the professor of that branch, Dr. John B. Biddle, who died January 19, 1879.

The degree of Doctor of Laws, LL.D., was conferred upon him June, 1883, by Dickinson College, Carlisle, Pa.

His second wife died January 9, 1883. This loss made a profound impression. Abated energy and impaired health followed. He resigned his office, July, 1884, and was elected emeritus professor.

He died September 6, 1884, in his seventy-second year.

The part given to Dr. Rogers to enact in this world has been well performed. He employed all his time advantageously in one direction or another. He was never idle. Besides his routine official work, he was sometimes engaged as an expert in criminal trials; often delivered lectures, illustrated by experiments, for the benefit of institutions; helped to release many a student from difficulties ascribable to his own heedlessness, and always had several decent poor people, old or enfeebled, depending upon his bounty, whom he cheered by familiar counsels and substantial gifts—little stipends to eke out their meagre earnings. He was ever ready to render aid in any emergency, small or great.

Late one summer evening, in 1863, strolling, as was then his wont, in the outskirts of the city, he was overtaken by a marketman slowly driving his wagon and horses in a south-westerly direction towards Gray's Ferry. The man asked if he was on the right road to the Indian Queen, on North Third street. The Doctor perceived that he was too much bewildered to take care of his charge, and with his consent at once took a seat beside him, and with his one hand drove the team to the tavern named.

One Sunday, at Long Branch, years ago, a gentleman who was bathing got beyond his depth and was borne seaward by the undertow. Two young men who were bathing at the same time saw his danger and hastened to his assistance; but when they reached him they were able to do little more than care for themselves. They could only now and then give him a little support and encourage him to continue his exertions to save himself.

Dr. Rogers saw their peril from the hotel and instantly started for the beach, undressing and throwing his clothes, containing

his watch, money, &c., on the ground as he ran, and reached it just in time to jump on board of a boat putting off to the rescue. The boat had proceeded only a short distance when it was swamped. Dr. Rogers seized an oar, swam to the drowning persons, gave it to them and urged them to sustain themselves till aid should arrive. The drifting boat was flung against one of the gentlemen and the oar was wrenched from him. Seeing this, Dr. Rogers placed himself in a manner under him, and thus bearing him up, brought him, as well as those holding fast to the oar, safely ashore.

And this was the third time he had heroically saved persons from drowning.

He had a remarkable facility in the use of tools of all kinds, and a respectable talent for mechanical contrivance. He was author of many inventions—notable among them the Rogers and Black steam boiler—and of several modifications and improvements of electric apparatus. This ability was early manifested, 1835–36, in his original experiments on osmosis, in which he demonstrated how changes in the blood are produced by respiration.

The tenderness of his nature may be discerned in the following sentences from the postscript of a letter to his brother William, May 6, 1833: "My Dear Brother—What can be more grateful to an affectionate heart than to find in others a sympathy and reciprocation of the same warm feelings it proffers. How doubly blessed do I consider myself when I feel that in my brothers I have found such beings.

"I had sealed this letter at home, but thinking it well before delivering it to the mail to inquire for letters, I have been rejoiced to find yours of the 2d of May, and thus I am enabled to acknowledge its receipt and, let me assure you, with a thousand thanks for its contents."

The Chairman of the Executive Committee, Dr. Samuel Ashhurst, of the Society of the Alumni of the Medical Department of the University of Pennsylvania, in the annual report for 1885, says: "Highly endowed with the qualities which make an attractive lecturer, Dr. Rogers was always popular with the large classes who for so many years obtained their elementary knowledge of chemistry from his instruction, while his genial manners and his amiability of heart made him beloved by very

many. Dr. Rogers took an active part in the formation of this Society, and acted as its Treasurer for several years. He left the record of a life in which integrity and gentleness were united with courtesy and energy in a high degree, and one of which this Society can affectionately take notice by these few memorial words."

When Margaret Rogers installed the lame boy whom she had trained to be master in the clay-walled school hut on the Edergole estate, she was probably conscious of doing rightly; but she did not foresee the benefit she was conferring on future generations of the house. The crop, the outcome of her planting, has been larger and better than she possibly could have dreamed. The inborn desire, the disposition of Patrick to learn, was quickened and fostered there. He imparted it to his sons, the brothers Rogers. All came to be professors, all were recognized by the educational classes to be among the efficient and eminent, and all were prominent among the votaries of science.

When their father died their means were insufficient. The appointment of William in the College of William and Mary was a god-send. He generously helped his brothers from the income of his office. Indeed, until all had placed themselves beyond need, the full purse, no matter who of the four held it, was regarded to be a common resource. They helped each other as occasion required.

Their published writings, a list of which is appended, imply industry, as well as harmony of purpose and pursuit.

Besides published books and reports, William contributed to scientific serials and periodicals forty-nine, and Henry thirty-four papers. James and Robert were co-laborers. William and Henry were joint authors of eight, and Robert and William of nineteen papers.

The brothers were full of zeal for the growth and diffusion of knowledge; and, habitually scanning German, French, English and American scientific periodicals, they were ever informed of the last step of its progress. Whenever they met, after more or less prolonged separations, the scientific topic of the day was sure to be a chief subject of conversation.

In blood and lineage the brothers Rogers were Irishmen; but the locality of their birth and education made them loyal Americans, and exemplary citizens.

It is related that at a dinner party, in Glasgow, just at the close of the rebellion, a guest, who was somewhat enthusiastic in predicting the success of the rebels, in a taunting tone called upon Professor H. D. Rogers, at the opposite end of the table, to tell the company his opinion of the chance of preserving the Union. Thus interrupted while speaking with a guest seated next to him, he quietly replied, "We shall see, sir," and resumed his conversation.

The next morning the papers announced Lee's unconditional surrender, and collapse of the rebellion.

Professor Rogers saw the gentleman approaching him from a distance, but, as if he wished to avoid a meeting, he crossed to the opposite side of the street and bestowed his whole attention upon a shop window. Professor Rogers was soon at his side and said emphatically, "Good morning, Mr. ————. We have seen, sir." Then, without waiting for a reply, walked on.

The brothers Rogers were highly gifted. They possessed a vigorous and quick understanding, invincible diligence happily combined with those moral and intellectual attributes which are essential to a truly manly character. They were efficient teachers. The conception of the subject of their lessons was always clearly defined in all its details and relations, which were presented with nicely devised experimental illustrations and apt fluency of speech rarely excelled. They imparted their knowledge to thousands of pupils, many of whom in turn imparted it to others. Within the limits of the field which they cultivated, few have wrought more acceptably or more usefully than the brothers Rogers.

> "Who kindly shows a wanderer his way,
> Lights, as it were, his torch from his own torch—
> In kindling others' light, no less he shines."

Life—the incomprehensible, intrinsic, conservative force of every organism which imparts motion to its structures without essentially changing their composition or altering their relations during an indefinitely limited period—that earthly life has departed from the brothers. Their tasks have been completed, and their value computed; but their names without a dimmed spot or smirch upon them are fixed along paths of knowledge and may still help to light others on the way, as long as their sheen is discernible. And thus, the influence of their lives may be prolonged through their example and work.

List of the Published Writings of Patrick Kerr Rogers, M.D., Professor of Natural Philosophy and Chemistry in the College of William and Mary, Williamsburg, Va.

An Investigation of the properties of the Liriodendron Tulipifera, or Poplar Tree. By Patrick Kerr Rogers, formerly of Ireland; now of Philadelphia; Honorary Member of the Medical and Chemical Societies.

"The man who discovers one valuable new medicine is a more important benefactor to his species than Alexander, Cæsar or an hundred other conquerors. Even his glory, in the estimation of a truly civilized age, will be greater and more lasting."—Professor Barton.

8 vo, pp. 64. Printed by Benjamin Johnson, Philadelphia, 1802.

A case of Epilepsy, successfully treated by the Nitrate of Silver; in a letter to the Editor, from P. K. Rogers, M.D., of Philadelphia. First Supplement to the Med. and Physical Journal. Philad., 1806, pp. 12–15.

A case of Tetanus, cured by injections of Tobacco, &c. In a letter to the Editor, from P. K. Rogers, M.D., of Philadelphia. Philad. Med. and Physical Jour., 1808, iii, pp. 90–95.

Papers in defense of Inoculation in preference to Vaccination. American and Commercial Advertiser. Baltimore, Jan. 12, Feb. 19, March 19, 1816.

Preparation of Mercurial Ointment. By Patrick Kerr Rogers, M.D., of Baltimore. Amer. Med. Recorder, 1819. pp. 331–338.

Observations on the Employment of Caustic Issues in the treatment of various diseases. By P. K. Rogers, M.D., Professor of Natural Philosophy and Chemistry, Williamsburg, Va. Amer. Med. Recorder, 1822, v, pp. 216–224.

An Introduction to the Mathematical Principles of Natural Philosophy, adapted to the use of Beginners; and arranged more particularly for the convenience of Junior Students of William and Mary College, Virginia. By Patrick Kerr Rogers, M.D., Professor of Natural Philosophy and Chemistry, William and Mary. Shepperd & Pollard, *Printers*. Richmond, 1822. 8vo, pp. 144.

List of Published Writings of James B. Rogers, M.D.

Minutes of Analysis of Soup containing Arsenic. By Dr. James B. Rogers, George W. Andrews and Wm. R. Fisher. *Baltimore, April 1, 1834.* Amer. Jour. Pharmacy, vi, 94, July, 1834.

James B. Rogers and James Green.

Experiments with the elementary Voltaic Battery. Silliman, Journ., xxviii, 1835. pp. 33–42.

Elements of Chemistry, including the history of the Imponderables and the Inorganic Chemistry of the late Edward Turner, M.D., F.R.S.L. & E., Seventh edition; and the Outlines of Organic Chemistry. By William

Gregory, M.D., &c., Professor of Chemistry, University of Edinburgh. With notes and additions. By James B. Rogers, M.D., Professor of Genral Chemistry, Franklin Institute, and Lecturer on Medical Chemistry, &c., and Robert E. Rogers, M.D., Professor of Chemistry and Materia Medica, University of Virginia, &c. 8vo, pp. xxii—848. Thomas Cowperthwait & Co. Philadelphia, 1846.

JAMES B. AND ROBERT E. ROGERS.

On the alleged insolubility of Copper in Hydrochloric Acid; with an examination of FUCH'S method for analyzing iron ores, metallic iron, etc. Proc. Amer. Assoc., 1848, p. 39; Silliman, Journ., vi, 1848, pp. 395–396.

LIST OF THE PUBLISHED WRITINGS OF WM. B. ROGERS, LL.D.

Essays on the Weather—On the formation of dew—several articles. The Messenger of Useful Knowledge. Carlisle, Pa. 1830.

Analysis of Shells. Silliman, Journ., xxvi, pp. 361–365. 1834.

On the Discovery of Green Sand in the Calcareous Deposit of Eastern Virginia, and on the probable existence of this substance in extensive beds near the western limits of our ordinary Marl. Farmers Register, June 26–27, 1834, and May, 1835. Reprinted. Geology of the Virginias.

On the existence of bi-malate of lime in the berries of the Sumach; and the mode of procuring it from them in the crystalline form. Silliman, Journ., xxvii, 1835, pp. 294–299.

Apparatus for analyzing Calcareous Marl and other Carbonates. Silliman, Journ., xxvii, 1835, pp. 299–301.

Self-filling Syphon for Chemical Analysis. Silliman, Journ., xxvii, 1835, pp. 302–303.

Report of the Geological Reconnoissance of the State of Virginia. Made under the appointment of the Board of Public Works. By William B. Rogers, Professor of Natural Philosophy in the University of Virginia. DeSilver Thomas & Co. Philad., 1836. 8vo, pp. 143.*

Report of the Progress of the Geological Survey of the State of Virginia, for the year 1836. pp. 24.*

Report of the Progress of the Geological Survey of the State of Virginia, for 1837. pp. 43.*

Report of the Progress of the Geological Survey of the State of Virginia, for 1838. pp. 56.*

An Elementary Treatise on the strength of Materials: Being the substance of the lectures on that subject, delivered in the School of Engineering of the University of Virginia. By Wm. B. Rogers, Professor of Natural Philosophy in that Institution. 8vo, pp. 50. Printed by Tomkins & Noel, Charlottesville, 1838. [Copy Presented to the Franklin Institute by Wm. B. Rogers.]

* Reprinted in the Geology of the Virginias, 1884.

Report of the Progress of the Geological Survey of the State of Virginia, for 1839. pp. 167.*

Report of the Progress of the Geological Survey of the State of Virginia, for 1840. pp. 127.*

Report of the Progress of the Geological Survey of the State of Virginia, for the year 1841. pp. 31.*

On the Age of the Coal Rocks of Eastern Virginia. Trans. Assoc. Amer. Geologists and Naturalists, 1840–42. pp. 14, plate 1.*

Some observations of Subterranean Temperature in the Coal Mines of Eastern Virginia. Trans. Amer. Assoc. Geologists and Naturalists, 1840–42. pp. 9.*

On the connection of Thermal Springs in Virginia with Anticlinal Axes and Faults. Trans. Amer. Assoc. of Geologists and Naturalists, 1840–42. pp. 23.*

On the age of Coal Rocks of Eastern Virginia. Amer. Geol. and Nat. Assoc. Reports, 1843, pp. 298–316.

On the connection of Thermal Springs in Virginia with Anticlinal Axes and Faults. Amer. Geol. and Nat. Ass. Reports, 1843, pp. 323–347.

Observations of Subterranean Temperature of the Coal Mines of Eastern Virginia. Amer. Geol. and Nat. Assoc. Reports, 1843, pp. 532–538; Bibl. Univ., xlv, 1843, pp. 393–394.

On the Phenomena of the great Earthquakes which occurred during the past Winter, one in this country and the other in the West Indies, and on a general theory of Earthquake Motion. Proc. Amer. Phil. Soc., iii, 1843, pp. 64–67.

An account of some new Instruments and Processes for the analysis of the Carbonates. Silliman, Journ., xlvi, 1844, pp. 346–359.

A system of classification and nomenclature of the Palæozoic Rocks of the United States, with an account of their distribution, more particularly in the Appalachian mountain chain. Silliman, Journ., xlvii, 1844, pp. 111–112.

On the Gold Region of the United States. Proc. Amer. Assoc. Adv. Science, 1850. p. 20.

On Mechanical Powers. Proc. Amer. Assoc. Adv. Science, 1850. p. 16.

On Acid and Alkaline Springs. Amer. Assoc. Proc., 1848. pp. 94–95; Silliman, Journ., ix, 1850, pp. 123–126.

Elements of Mechanical Philosophy, for the use of the Junior Students of the University of Virginia. By Wm. B. Rogers, Professor of Natural Philosophy and Geology in the University. 8vo, pp. 339. Thurston, Torry & Emerson, Printers. Boston, 1852.

On Binocular Combinations. Proc. Amer. Acad., iii, 1852–57, p. 213.

On the Ozonometer. Proc. Amer. Acad., 1852–1857, p. 220.

Report on the Pridevale Coal and Iron Ore, West Virginia, 1854. pp. 27.*

*Reprinted in the Geology of the Virginias, 1884.

Observations on the Natural Coke and the associated igneous and altered Rocks of the Oölite Coal Region in the vicinity of Richmond, Va. pp. 2. Proc. Boston Soc. Nat. Hist., 1854–56.*

Proofs of the Prozoic Age of some of the altered Rocks of Eastern Massachusetts from fossils recently discovered. Proc. Amer. Acad. Arts and Sc., iii, 1852–57. pp. 315–318.

Results of Calculations of the Terminal Velocity of Rain-drops of different diameters. Proc. Boston Nat. Hist. Soc., v, 1854–56, pp. 266–268, 282–283.

On the Relations of the New Red Sandstone of the Connecticut valley and the coal-bearing Rocks of Eastern Virginia and North Carolina. Silliman, Journ., xix, 1855, pp. 123–125.

Observations on Binocular Vision. Silliman, Journ., xx, 1855, pp. 86–93, 204–220, 318–335 ; xxi, 1856, pp. 80–95, 173–188.

On the form of the Curve resulting from the Binocular union of a Straight Line with a Circular Arc or of two Equal Circular Arcs with one another. Edinb. New Phil. Journ., iii, 1856, pp. 210–218.

On the Discovery of the Paradoxides in the altered Rocks of Eastern Massachusetts. Edinb. New Phil. Journ., iv, 1856, pp. 301–304.

Discovery of Palæozoic Fossils in Eastern Massachusetts. Silliman, Journ., xxii, 1856, pp. 296–298.

On the Origin and Accumulation of the Protocarbonate of Iron in Coal Measures. Silliman, Journ., xxi, 1856, pp. 339–343.

On Ozone in the Atmosphere. Silliman, Journ., xxii, 1856, pp. 141–142.

Brief Account of the Construction and Effects of a very powerful Induction Apparatus, devised by Mr. E. S. Ritchie. Brit. Assoc. Rep., 1857 (pt. 2), pp. 15–16.

On a New Stereoscopic Slide. Proc. Amer. Assoc., iv, 1857–60. pp. 360–362.

Some Experiments on Sonorous Flames, with remarks on the primary source of their vibration. Silliman, Journ., xxvi, 1858, pp. 1–15 ; Proc. Boston Nat. Hist. Soc., vi, 1856–59, pp. 333–335, 339–340, 346–352.

On the Origin of Sonorous Vibrations produced under certain conditions by flames from wicks or wire-gauze. Silliman, Journ., xxvi, 1858, pp. 240–241.

On the Formation of Rotating Rings by Air and Liquids under certain conditions of discharge. Silliman, Journ., xxvi, 1858, pp. 246–253.

On Ozone Observations. Edinb. New Phil. Journ., vi, 1858, pp. 35–42.

On some Sonorous Flames. Phil. Mag., xv, 1858, 261–263.

Examination of Japanese Vegetable Wax. Proc. Boston Nat. Hist. Soc., vii, 1859–61, pp. 58–59.

Observations on the Coiling of the Tendrils of the Winter Squash. Proc. Boston Nat. Hist. Soc., vii, 1859–61, pp. 409–411.

Some Experiments and Inferences in regard to Binocular Vision. Proc. Amer. Assoc., 1860, pp. 187–192 ; Silliman, Journ., xxx, 1860, pp. 387–390.

* Reprinted in the Geology of the Virginias, 1884.

On our Inability from the Retinal Impression alone to determine which Retina is impressed. Proc. Amer. Assoc., 1860, pp. 192–198; Silliman, Journ., xxx, 1860, pp. 404–409.

Experiments and Conclusions on Binocular Vision. Brit. Assoc. Rep., 1860 (pt. 2), pp. 17–18.

On the Phenomena of Electrical Vacuum Tubes. Brit. Assoc. Rep., 1860 (pt. 2), pp. 30–31.

Notes on the Aurora of the 28th of August, and several subsequent nights, as observed at Lunenburg, Massachusetts, Lat. 42° 35′. Edinb. New Phil. Journ., xi, 1860, pp. 90–99; Silliman, Journ., 1860, pp. 255–256.

Observations on Albertite, or so-called Albert coal of New Brunswick. Proc. Acad. Nat. Sc. Philadelphia, 1860, xii, p. 98.

On the Causes which gave rise to the generally elongated form and parallel arrangement of the pebbles in the Newport Conglomerate. Silliman, Journ., xxxi, 1861, pp. 440–442.

Coal, working power of. Mechanics Mag. London, 1861. Amer. Jour., Pharmacy, 1862, p. 90.

Electric illumination at Boston. Photometrical powers of the light. Amer. Journ. Sci., xxxvi, 1863, pp. 307–308.

An Account of Apparatus and Processes for the chemical and photometrical testing of Illuminating Gas. Brit. Assoc. Rep., xxxiv, 1864 (*Sect.*), pp. 39-40.

On the Gravel and Cobble-Stone Deposits of Virginia and the Middle States. pp. 5. Proc. Boston Nat. Hist. Soc., 1875.*

Infusorial Deposit of Virginia in the Fort Monroe Artesian Well. pp. 4. 1882.

Notes from Macfarlane's Geological Railway Guide [corrected to 1883], pp. 14.*

By William B. and Henry D. Rogers.

Contributions to the Geology of the Tertiary Formations of Virginia. 5 plates, pp. 13. Trans. Amer. Philos. Soc., 1835–37.

On the Physical Structure of the Appalachian Chain, as exemplifying the laws which have regulated the elevation of great mountain chains generally. 3 plates, pp. 42. Trans. Assoc. Amer. Geologists and Naturalists.*

By William B. and Robert E. Rogers.

On the Absorption of Carbonic Acid Gas by Sulphuric Acid. Chemical Gazette, vi, 1848, pp. 477–480.

On the Volatility of Potassa and Soda and their Carbonates. Proc. Amer. Assoc. Advanc. of Sc., Sept., 1848, pp. 36–38.

On the Decomposition of Rocks by Meteoric Agents, and on the action of Mineral Acids on Feldspar. Amer. Jour. Science and Arts, v, p. 401.

On the Decomposition of Rocks by Meteoric Water. Proc. Amer. Assoc. Advanc. Sc., Sept. 1848, p. 60.

* Reprinted in the Geology of the Virginias, 1884.

On the Absorption of Carbonic Acid by Liebig's dilute solution of Phosphate of Soda. Proc. Amer. Assoc. Advanc. Sc., 1848, p. 62.

On the Comparative Solubility of the Carbonate of Lime and the Carbonate of Magnesia. Proc. Amer. Assoc. Advanc. Sc., 1848, p. 95.

On the Absorption of Carbonic Acid by Acids and Saline Solutions. Proc. Amer. Assoc. Advanc. Sc., 1850, p. 293–308.

List of the Published Writings of Henry D. Rogers, LL.D., &c.

Some Facts in the Geology of the Central and Western portions of North America, collected principally from the Statements and unpublished Notices of recent Travellers [1834]. Geol. Soc. Proc., ii, 1833–38, pp. 103–106.

Report on the Geology of North America. Brit. Assoc. Rep., 1834, pp. 1–66.

On the Proposed Method [Cohen's] of Analyzing Mineral Waters by Alcohol. Jour. Philad. Coll. Pharm., v, 1834, pp. 279–284.

Analysis of some of the Coals of Pennsylvania. Jour. Acad. Nat. Sc. of Philad., vii, 1834, pp. 158–177.

On the Falls of Niagara and the reasoning of some Authors respecting them. Silliman, Journ., xxvii, 1835, pp. 326–335; Edinb. New. Phil. Jour., xix, 1835, pp. 281–292; Froriep, Notizen xlvi, 1835, col. 305–314.

Report on the Geological Survey of the State of New Jersey. 8 vo, pp. 175. DeSilver Thomas & Co., Philadelphia, 1836.

A Guide to a course of Lectures on Geology delivered in the University of Pennsylvania. 8 vo, pp. 43.

Description of the Geology of the State of New Jersey, being a final report. 8vo, pp. 301. C. Sherman & Co., Printers. Philadelphia, 1840.

Annual Report of the Geological and Mineralogical Survey of Pennsylvania, for 1836, 8 vo, pp. 22; for 1838, pp. 93; for 1839, pp. 119; for 1840, pp. 252; for 1841, pp. 179; for 1842, pp. 28.

Account of the Mammoth Cave of Kentucky. Proc. Boston Soc. Nat. Hist., 1841–44.

An Inquiry into the Origin of the Appalachian Coal Strata, Bituminous and Anthracite. Amer. Geol. and Nat. Assoc. Reports, 1843, pp. 433–474.

Researches in Relation to the recent Earthquakes with a New Theory of Earthquake Action. Silliman, Jour., xlv, 1843, pp. 341–347.

Transition Rocks (Palæozoic Rocks) of North America. Edin. New Phil. Journ., xxxvii, pp. 392–395.

Remarks on the prevailing Hypotheses in explanation of the Phenomena of the Drift. Proc. Amer. Geol. and Nat. Assoc., 1845, pp. 12–14.

On the direction of the Slaty Cleavages in the Strata of the south-eastern belts of the Appalachian Chain, and the parallelism of the Cleavage Dip with the planes of Maximum Temperature. Proc. Amer. Geol. and Nat. Assoc., 1845, pp. 49–50.

Remarks upon the question of the Taconic Rocks, as a separate and in-

dependent System of Strata. Proc. Amer. Geol. and Nat. Assoc., 1845, pp. 66–67.

On the Geology of Pennsylvania. Brit. Assoc. Rep., 1848 (pp. 2), pp. 74–75.

On the structural features of the Appalachians, compared with those of the Alps and other disturbed districts of Europe. Proc. Amer. Assoc., 1849, pp. 113–118.

On the Analogy of the Ribbon Structure of Glaciers to the Slaty Cleavage of Rocks. Proc. Amer. Assoc., 1849, pp. 181–192.

On the Origin of the Drift, and of the Lake and River Terraces of the United States and Europe, with an examination of the Laws of Aqueous Action connected with the Inquiry. Proc. Amer. Assoc., 1849, pp. 239–255.

On the Coal Formation of the United States and especially as developed in Pennsylvania. Proc. Amer. Assoc., 1850, pp. 65–70.

On the Connection of the deposits of Common Salt with Climate. Proc. Amer. Assoc., 1850, pp. 126–127.

On the Position and Character of the Reptilian Foot-prints in the Carboniferous Red Shale Formation of Eastern Pennsylvania. Proc. Amer. Assoc., 1850, pp. 250–251.

On the Origin of Salt and Salt Lakes. Edin. New Phil. Journ., li, 1851, pp. 130–132.

On the probable Depth of the Ocean of the European Chalk Deposits. Proc. Boston Nat. Hist. Soc., iv, 1853, pp. 297–298; Silliman, Journ., xvii, 1854, pp. 131–132.

On the Epoch of Elephas primigenius. Proc. Boston Nat. Hist. Soc., v, 1854–56, pp. 22–23.

On Fossil Impressions in Red Shale of Anthracite Coal Measures of Pennsylvania. Proc. Boston Nat. Hist. Soc., v, 1854–56, pp. 182–186.

On the Geology and Physical Geography of North America. Proc. Roy. Inst., ii, 1854–58, pp. 167–187.

On the correlation of the North American and British Palæozoic Strata. Brit. Assoc. Rep., 1856 (pt. 2), pp. 175–186.

Classification of the Metamorphic Strata of the Atlantic Slope of the Middle and Southern States. Proc. Boston Nat. Hist. Soc., vi, 1856–59, pp. 140–145.

Introductory observations to L. Lesquereux's paper on New Species of Fossil Plants, from the Anthracite and Bituminous Coal Fields of Pennsylvania. Boston Journ. Nat. Hist., vi, 1857, pp. 409–413.

On the Laws of Structure of the more disturbed Zones of the Earth's Crust [1856]. Edinb. Roy. Soc. Trans., xxi, 1857, pp. 431–472.

On the Origin of the "Parallel Roads" of Lochaber. Proc. Roy. Inst., iii, 1858–62, pp. 341–345.

The Geology of Pennsylvania; A Government Survey. By Henry Darwin Rogers, State Geologist; Professor of Natural History in the University of Glasgow; F.R.S.E.; F.G.S.; Member of the American

Philosophical Society; Fellow of the Boston Academy of Arts and Sciences; Member of the Boston Nat. Hist. Society, &c., &c. In two volumes. Quarto, I. pp. xxiv, 586. 32 full page illustrations and 136 cuts; II. pp. xxiv, 1045. 42 plates and 778 cuts. Printed by William Blackwood & Sons, Edinburgh. J. B. Lippincott & Co., Philadelphia, 1858.

On the Distribution and Probable Origin of the Petroleum, or Rock-oil of Western Pennsylvania, New York and Ohio. Proc. Glasgow Phil. Soc., iv, 1860, pp. 355–359.

On the Relations of Deposits of common Salt to Climate. [1860.] Proc. Glasgow Phil. Soc., v, 1864, pp. 7–9.

On the Origin of Cyclones. [1861.] Proc. Glasgow Phil. Soc., v, 1864, pp. 57–60.

Report on the Wheatley and Brookdale Mines, Chester Co., Penna. New York Mining Mag., pp. 375–387.

On the Pleistocene Glacial Climate of Europe. [1865.] Proc. Boston Nat. Hist. Soc., x, 1866, p. 241–245.

On Petroleum. [1865.] Proc. Glasgow Phil. Soc., vi, 1868, pp. 48–61.

By Henry D. and William B. Rogers.

Experimental Inquiry into some of the Laws of the Elementary Voltaic Battery. Silliman, Journ., xxvii, 1835, pp. 39–61.

Contributions to the Geology of the Tertiary Formations of Virginia. Amer. Phil. Soc. Trans., v, 1837, pp. 319–331; vi, pp. 347–377.

Observations on the Geology of the Western Peninsula of Upper Canada and the Western part of Ohio. [1841]. Amer. Phil. Soc. Trans., viii, 1843, pp. 273–284.

On the Phenomena and Theory of Earthquakes and the Explanation they afford of certain facts in Geological Dynamics. Brit. Assoc. Rep., 1843 (pt. 2), pp. 57–59.

An Account of two remarkable Trains of Angular Erratic Blocks, in Berkshire, Massachusetts; with an attempt at an explanation of the Phenomena. Boston Journ. Nat. Hist., v, 1845–47, pp. 310–329.

On the Geological Age of the White Mountains. Silliman, Journ., i, 1846, pp. 410–421.

By Henry D. Rogers and Martin H. Boye.

Upon a New Compound of the Deutochloride of Platinum, Nitric Oxide and Chlorohydric Acid. Amer. Philos. Soc. Trans., vii, 1841, pp. 59–66; Liebig Annalen, xl, pp. 289–290.

List of the Published Writings of Robert E. Rogers, M.D., LL.D., &c.

Experiments on the Blood, together with some New Facts in regard to Animal and Vegetable Structures, illustrative of many of the most important Phenomena of Organic Life, among them Respiration, Animal Heat,

Venous Circulation, Secretion and Nutrition. Amer. Journ. Med. Sci. xviii, 1836, pp. 277–301.

On a New Process for obtaining pure Chlorine Gas. Silliman, Journ. i, 1846, p. 428.

Report on the Consolidated Virginia and California Mines. Appendix No. 4. Annual Report of the Director of the Mint for the fiscal year ending June 30, 1875, p. 81–83.

Report on the Equipment of the New Refinery in the Mint at San Francisco. App. No. 4. Ann. Rep. of the Director of the Mint, for the year ending June 30, 1875, pp. 83–88.

By Robert E. and William B. Rogers.

On a new Process for obtaining Formic Acid, and on the preparation of Aldehyde and Acetic Acid by the use of the Bichromate of Potassa. Silliman, Journ., ii, 1846, pp. 18–24.

On the Volatility of Potassa and Soda, and their Carbonates. Amer. Assoc. Proc. 1848, pp. 36–38.

On the Decomposition of Rocks by Meteoric Water. Proc. Amer. Assoc., 1848, pp. 60–62.

On the Comparative Solubility of the Carbonate of Lime and the Carbonate of Magnesia. Proc. Amer. Assoc., 1848, pp. 95–97.

On a new Process for analyzing Graphite, natural and artificial. Brit. Assoc. Rep., 1848 (pt. 2), pp. 59–60; Edin. Journ. Prak. Chem., l, 1850, pp. 411–413; Journ. de Pharm., 1851, pp. 67–68.

Oxidation of the Diamond in the liquid way. Brit. Assoc. Rep., 1848, (*pt.* 2), pp. 60–61; Edinb. New Phil. Journ., xlv, 1848, pp. 388–389; Silliman, Journ., vi, 1848, pp. 110–111.

On the Absorption of Carbonic Acid by Water, Saline Solutions and various other Liquids [1847]. Silliman, Journ., v, 1848, pp. 114–115.

New Method of Determining the Carbon in native and artificial Graphites, &c. Silliman, Journ., v, 1848, pp. 352–359.

On the Decomposition and Partial Solution of Minerals, Rocks, &c., by pure Water, and Water charged with Carbonic Acid. Silliman, Journ., v, 1848, pp. 401-405. Brit. Assoc. Rep., 1849 (pt. 2), pp. 40-42; Edinb. New Phil. Journ., xlv, 1848, pp. 163–168; Froriep. Notizen, ix, 1849, col. 49–53; xi, 1849, col. 305–309.

On the Absorption of Carbonic Acid by Liquids. Silliman, Journ., vi, 1848, pp. 96–110.

On the Absorption of Carbonic Acid by Acids and Saline Solutions. Amer. Assoc. Proc., iv, 1850, pp. 298–308.

On the Use of Hydrogen Gas, to displace Sulphuretted Hydrogen in the analysis of Mineral Waters, &c. Silliman, Journ., xviii, 1854, pp. 213–216.

By Robert E. Rogers and Martin H. Boye.

On the Analysis of Limestones, especially the Magnesian Kind, and a method of completely separating Lime from Magnesia when both are pres-

ent in large quantity. Journ. Franklin Inst., xxv, 1840, pp. 158–162; Sturgeon. Ann. Elec., v, 1840, pp. 203–208.

By Dr. H. R. Linderman and Prof. Robert E. Rogers

Report upon the Wastage of Silver Bullion in the Melter and Refiner's Department of the Mint of the United States, July 25, 1872. 8vo, pp. 82. Government Printing Office, Washington, 1872.

Report of the Committee [Franklin Institute] on Dynamo-Electric Machines. Journ. Franklin Institute, lxxv, 1875, p. 289–303.

Report of the Committee [Franklin Institute] on the precautions to be taken to obviate the dangers of Electric Lighting. Journ. Franklin Institute, Dec., 1881. lxxxii, pp. 401–408.

Note.—In the preparation of the above lists, the Catalogue of Scientific Papers, 1800-1873, compiled and published by the Royal Society of London, has been consulted and used.

Report on the Coal Deposits near Zacualtipan, in the State of Hidalgo, Mexico. By E. D. Cope.

(*Read before the American Philosophical Society, Oct. 16, 1885.*)

Having obtained in the City of Mexico favorable information as to the coal of Zacualtipan, in the State of Hidalgo, I resolved to devote some time to an investigation of that locality.

On my arrival at Zacualtipan, I was informed by my friend, Dr. Santiago Bernad, a French physician, who practices in the town and its surrounding region, that the coal beds extend throughout a distance of five leagues north and south, and two and a half leagues east and west. They are owned in large tracts called quadras by different persons. I examined sixteen exposures within a distance of five miles of Zacualtipan, northeast, south-east and south, with the following results:

The geological structure of the country is as follows: The town of Zacualtipan is situated on the border of the plateau of Mexico, where it begins to break off to the lower level, which two days' journey on horseback eastward becomes the Tierra Caliente of the State of Vera Cruz. The plateau is, therefore, much broken by ravines which open to the eastward. The high plateau just east of Zacualtipan is about 7000 feet above sea-level. The eastern border of the plateau is supported and protected by the lines of several trap-dykes, whose faces form precipitous walls which bound the ravines, generally on one side. To the east and west of the town the high lands consist of a silicious limestone, which looks a good deal like that of subcarboniferous age in the United States, but, is said by M. Barcena, of the National Museum of Mexico, to be of Cre-

taceous age. This limestone lies elevated at a high angle against the trap-dyke, at a point on the San Miguel creek; showing, first, that the trap formation is a dyke which has been thrust up from below, and is not an outflow; and second, that the age of the elevation of the dyke is later than the Cretaceous period. This conclusion is all important in the determination of the age, and, therefore, probable quality of the coal, and in the determination of its quantity.

The coal formation lies horizontally bedded in the intervals between the trap-dykes and the hills of limestone, etc. It consists of regularly stratified beds of clay, of volcanic ash, of clay or carbonaceous shales, more or less finely bedded, and of thicker and thinner beds of a frequently very good lignite coal. There are no beds of stone in them, but the carbonaceous shales are frequently very tough. The bedding has not been affected by the dykes, and indeed sometimes inclines downwards towards them at a low angle, instead of upwards towards them as would have been the case had they been older than the dykes. Further evidence that the coal formation is newer or of later age than the dykes is seen in the fact that beds of coal are found in some localities on top of them. It follows from these facts that although there are beds above the dykes, there *is no coal* below the precipices which constitute the parts of the dykes which are visible; or, in other words, that the coal only occupies the spaces between the dykes. Fossil mammalian remains found in the beds of clay near the coal prove that the formation is of Upper Miocene Tertiary age, and perhaps identical with the epoch known in North America as that of the Loup Fork.*

The properties which I examined bear the following names: Galiana, Hulla, Juarez, Concha, Providencia, Capa Rosa, Sausz, San Miguel and San Rafael. I take them up in order. I premise by saying, that the coal beds have been rendered accessible by the erosion of the middle parts of the valleys which they occupy, into deep ravines. The coal outcrops are on the sides of these ravines, and extend underground to a line which descends vertically continuous with the faces of the trap precipices, at which point they are cut off by the concealed part of the dyke. The amount of coal is of course to be determined from this dimension, *i. e.*, the distance from the dyke multiplied by the extent of the formation parallel to the dyke, by the thickness of the bed.

The coal beds are best exposed on the Galiana property. From the top of the trap dyke to the bottom of the valley at this point, the vertical depth is about one thousand feet. At a depth of about 100 feet from the summit of the hill is a short, open cut in which can be seen a bed of good coal of eighteen inches in thickness. From its position, this bed probably extends entirely across the summit of the hill, and crops out on the other side, forming the San Rafael mine. Below this open cut the summit of the trap precipice is soon

*See American Naturalist, May, 1885, where this fact is stated. See also description of fossils at end of this article.

reached. The foot of the precipice is perhaps 400 feet below the coal bed, and at its foot is a gently sloping plateau of perhaps a quarter of a mile in width. The slope than becomes more abrupt, and descends to the bottom of the ravine-like valley, 500 feet below. At a depth of fifty feet vertically below the foot of the precipice at the beginning of the steeper slope, the upper bed of this part of the Galiana crops out. It is one foot in thickness, and is of good quality. Some eighteen inches of clay intervene between it and a second bed of coal of about three feet in thickness. About forty feet below their level is a bed of impure lignite eighteen inches thick; and below three or four feet of clay is a bed of better lignite which varies from two to six inches in thickness. Below this are about eighteen feet of carbonaceous clay and shale, and below this fifteen feet of clay with thin seams of lignite. Below this succeed white slates and clay with vertebrate fossils, chiefly three-toed horses, but no more coal.

The workable beds of coal in this property are the eighteen inch bed above the precipice, and the eighteen and thirty-six inch beds below the precipice. At present these beds are only exposed in open cuts. Those below the precipice have a quarter mile (English) extent to the trap dyke, while their extent parallel to the dyke is probably considerable. In fact, the coal formation follows the borders of the dykes at varying distance, and the outcrop thus has many miles of extent. The workings on the Galiana property consist of nothing but the open cuts mentioned. The clay is of excellent quality, and is manufactured by the owner into roofing tile.

The Hulla and Juarez mines are on the other sides of the same trap plateau. The highest coal outcrop of the Hulla is above the dyke precipice on the opposite side from the highest exposure on the Galiana, and is probably the same bed. This will therefore be about a third of a mile between the two outcrops. The bed is, however, thinner on the Hulla side, being only six inches in depth. The same is true of the other outcrops on the Hulla side. The second one is perhaps 500 feet lower down towards the bottom of the valley. There are open cuts, but the principal exposure is clay, carbonaceous and otherwise, with a bed of pure lignite of six inches thickness. At the Juarez outcrop, several hundred feet lower down, the lignite bed is only an inch in thickness.

The Concha and Providencia mines lie south-east of Zacualtipan, and below the trap precipice already described. They are, however, near to another mass of trap which may be a part of a different, or a branch of the same great dyke. The Concha is developed by both an an open cut and a timbered drift. The bed of coal varies from thirty to eighteen inches in thickness, and lies between more or less shaly beds of clay. They all dip at a low angle towards the trap. This coal looks well, but the extent of the bed *in one direction* is probably reduced by the not far-distant dyke. Lower down the hill we sought for another outcrop on the Concha property, but it had been covered up. An eighth of a mile round the hill from this lower level, in the side of a ravine is a cut, which displays the bed of

the Providencia mine. This varies in thickness from eighteen to thirty inches. In one direction it is limited by a trap dyke at a distance of about 100 yards, whose exposed face is less than 100 feet in height.

South of Zacualtipan are situated the Guadalupe, Capa Rosa, Sausz and San Miguel mines. At the Guadalupe are two timbered drifts, whose length I did not explore, as they contained much water, and were more or less dangerous. The cuts at their mouths in the hillsides reveal their structure and general value. The rock consists of clay and clay shales more or less carbonaceous, not hard, but tough. The lignite proper is from six to ten inches in thickness. This cut is near the base of the trap precipice. The second cut is 150 feet off, and is that much further from the trap. It displayed much the same structure and quantity of lignite.

The Capa Rosa exposure is on another side of the same hill, and is a quarter of a mile from the precipice, thus giving promise of greater dimensions of the deposit in one direction. It is at nearly the same horizon as the Gaudalupe, and may be the same bed. It is developed by an open cut which shows as follows: Below fifteen feet of soil there are twelve feet of clays and slates. These alternate between more and less carbonaceous layers, and in the bottom there are in sight ten inches of lignite, and how much more I could not ascertain without excavations. Further down the same hill, about 100 feet vertical, is the Sausz mine. The beds are here exposed by an open cut and a drift; the latter in a ruinous condition. In the bottom of the openings is a foot of good looking lignite, and above it is a bed of clay three feet in depth; above that, six inches of carbonaceous clay slate.

A mile farther along the same valley is the San Miguel mine. Its bed is exhibited in one open cut, and in an exposure along the bank of the San Miguel creek at the water level. There are here eight inches of lignite like that of the Capa Rosa and the Sausz.

It is now easy to perceive that the aggregate quantity of coal in the country is large, but that it is spread over considerable space. It is also evident that the mining is easy, as the beds all crop out conveniently on the sides of valleys, and the drainage is also easy. There being no secure roof or hanging wall to the beds, all workings will have to be well timbered. This will not be expensive, as timber of excellent quality of oak, pine, etc., covers the hills everywhere, in close proximity to the coal openings. The localities which exhibit the greatest thickness of the beds are the Galiana and Concha properties. Those which promise the greatest horizontal extent of the bed in the direction of the dyke are the Galiana, the Capa Rosa, the Sausz and the San Miguel. The property which combines the two advantages is then the Galiana.

This region is accessible by rail as far as Pachuca, sixty miles distant. From Pachuca to Zacualtipan a railroad could be built by Tulancingo and Apulco, where is now a wagon road. Of this I am informed by various persons, among them by Professor Castillo of the School of Mines of Mexico. A direct line of road from Pachuca to Zacualtipan is impracticable or

very expensive, owing to the great inequalities of the country. It is not unlikely that at some future day, this coal will have an outlet to Tuxpan on the coast, which is due east from Zacualtipan.

Finally I refer to Dr. F. M. Endlich for information as to the quality of the coal and its availability for industrial purposes.

I add that several of the properties are in the state of Vera Cruz just over the line. The Galiana property is near the small village of Tehuichila, Vera Cruz.

Description of fossils.

HIPPOTHERIUM PENINSULATUM, sp. nov.

Crown of superior molar long, curved. Grinding face with anteroposterior diameter considerably exceeding the transverse. Internal column large, its section a narrow anteroposterior oval, with both borders convex. Internal enamel borders of internal crescents with a prominent loop at junction, the posterior one with its posterior loop much smaller than the column. A subquadrate area between the internal parts of the lakes, is connected by an enamel ridge with the anterior lake. Opposite and adjacent enamel borders of the lakes, with several close and deep plications, which nearly cut off the adjacent horns. In like manner the posterior horn of the posterior lake, and the anterior horn of the anterior lake are almost cut off by the deep complex infolding of the anterior and posterior borders respectively. The median and anterior external ribs of the crown are well developed, and there is but little cement on the grooves.

Measurements.		M.
Length of root, less crown		.050
Diameters of grinding face	anteroposterior	.018
	transverse	.015

This superior molar tooth indicates a small species of the genus, and one which is entirely typical in form. The plication of the enamel is greater than in any other species excepting the *H. gracile*. It resembles most of all the *H. venustum* of Leidy, which is of similar dimensions. In that species the style has a nearly circular section according to Leidy, which distinguishes it satisfactorily.

From the Loup Fork Shales of Tehuichila, Vera Cruz.

PROTOHIPPUS CASTILLI, sp. nov.

This horse is represented by a superior molar tooth of a larger animal than the species last described, and one only a little smaller than the zebra. It possesses the internal loops of the two internal crescents as in Hippidium and Protohippus, and without the bones of the feet it is impossible to determine to which genus it should be referred. The indication that it is a Hippidium, is derived from the relative proportions of the internal loops. The anterior of these is much larger than the posterior, and occupies the median position of the internal edge of the crown like the column in Hippotherium. Further approach to that genus is made by the con-

traction of its connection with the corresponding crescent. The section of this loop is a rather wide oval. The posterior loop has half the size, and if isolated would present the same form.

The crown of the tooth is of median length and is strongly curved inwards. Its grinding surface is a little wider than long, and is worn into two transverse angles, which pass through the concavities of the borders of the crown and lakes. It is not certain that this grooving in wear is a constant character.

The lakes are strongly convex inwards and their horns are wide and obtuse. Their borders are simple, there being no folds on the remote sides, and on the adjacent borders only one on the posterior and two on the anterior, of no great depth. There is no loop at the junction of the inner edges of the internal crescents. External ribs of crown prominent. Excepting these, the entire crown is enclosed in cementum.

Measurements.		M.
Length of crown		.040
Diameters of grinding face	anteroposterior	.021
	transverse	.023

This species differs from the *P. insignis*, *P. perditus* and *P. mirabilis*, with which it agrees in size, in the posterior production and angulation of the posterior border of the anterior inner column, and in the absence of plication of the borders of the lakes which are remote from each other. In this species the internal loops are of nearly equal size. I have dedicated it to my distinguished friend, Prof. Antonio de Castillo, Director of the School of Mines of the City of Mexico, to whom I am indebted for a knowledge of the locality described in the present paper.

Fig. 1.

Fig. 2.

Fig. 1. Superior molar tooth of right side of *Hippotherium peninsulatum* Cope grinding surface from below; natural size.

Fig. 2. The same of *Protohippus castilli* Cope; same view; natural size.

Stated Meeting, August 21, 1885.

Donations for the Library were received from the Department of Mines, Melbourne; the New Zealand Institute; the Asiatic Society of Japan; the Geological Committee of St. Petersburg; the K. K. Central-Anstalt für Meteorologie und Erd-Magnetismus, Vienna; the Deutsche Anthropologische Gesellschaft, Munich; Prof. C. D. E. Weyer of Kiel; the Zoölogischer Anzeiger, Leipzig; the Deutsche Geologische Gesellschaft, Berlin; the Académie Royale de Copenhague; the K. Akademie von Wetenschappen and the K. Zoölogisch Genootschap at Amsterdam; the Société Botanique, Luxembourg; the Nederlandsche Botanische Vereeniging; the Académie Royale de Belgique; the Sociétés de Geographie, Americaine de France, Annales des Mines, Maisonneuve frères et Ch. Leclerc, Editeurs, Paris; the Société Linnéene de Bordeaux; the R. Accademia dei Lincei, Rome; the Royal Institution of Great Britain; the Zoölogical Society, the Royal Astronomical Society and Society of Antiquaries of London, the Meteorological, London Nature, Journal of Forestry, Messrs. John Kinnersley Smythies, Joseph Prestwich, Benjamin Ward Richardson and John Hampden and Charles Ellis, publishers, London; the Geological Society of Glasgow; the Geological and Natural History Survey and Museum of Canada; the Canadian Institute; the Natural History Society of Montreal; the American Academy of Arts and Sciences, Boston; the Bostonian Society; the American Philological Society, American Academy of Arts and Sciences, Museum of Comparative Zoölogy and Drs. Samuel Abbott Green and H. A. Hagen of Cambridge; the Essex Institute; the American Journal of Science, Connecticut Academy of Arts and Sciences, American Oriental Society at New Haven; the New York Academy of Sciences, American Chemical Society, Meteorological Observatory, New York; Mr. John B. Smith, editor, Brooklyn; the Young Men's Association, Buffalo; the New Jersey Historical Society; the Franklin Institute, College of Pharmacy, Mercantile Library, the Real Estate Title Insurance and Trust Company,

American Naturalist, Drs. Richard B. Westbrook and Persifor Frazer, and Messrs. R. S. Culin, Henry Phillips, Jr., H. Carvill Lewis and Richard Meade Bache of Philadelphia; the Bookmart Publishing Company, Pittsburgh; the American Chemical Institute, and Johns Hopkins University; the Naval Institute; the War Department, Bureau of Education, United States National Museum, Department of State, United States Geological Survey, and Smithsonian Institution; Mr. J. Hotchkiss of Staunton, Va.; the Cincinnati Society of Natural History and Cincinnati Observatory; the Chicago Historical Society; Rev. Stephen D. Peet, and the Kansas Academy of Science.

Stated Meeting, September 18, 1885.

Donations for the Library were received from Prof. Ferdinando de Mueller of Melbourne; the Geological Survey of India; Mr. N. R. Pogson, Government Astronomer at Madras; L'Institut Egyptien; the Académie Impériale des Sciences de St. Petersbourg; the Société Impériale des Naturalistes de Moscow; the Ungarische Akademie de Wissenschaften; the Anthropologische Gesellschaft; the K. K. Geologische Gesellschaft in Wien; the K. K. Sternwarte at Prag; the Zoölogische Anzeiger from Leipzig; the Oberlausitze Gesellschaft der Wissenschaften at Görlitz; the K. Akademie der Wissenschaften, and the Deutsche Geologische Gesellschaft at Berlin; the Académie Royal Suédoise des Sciences at Stockholm; Prof. J. C. Wulff, Rektor of the University at Stockholm; the Vereins für vaterländische in Würtemberg; the Offenbach Verein für Naturkunde; the Académie Royale de Belgique; the Société Royale des Sciences de Liege; the Reale Accademia dei Lincei at Rome; the Comitato Geologico d'Italia; the Ministero di Agricoltura at Rome; Société Zoologique de France; the Société de Gèographie at Paris; the Musée Guimet; the Société d'Emulation d'Abbeville; the Instituto y Observatorio de Marina de San Fernando; the Royal Society of London; the Linnean, the Royal Astronomical and Royal Geographical Societies, the Geological and the Society of An-

tiquaries; London Nature; the Journal of Forestry; Prof. J. Bennet Lawes; the Royal Cornwall Polytechnic Society; the Scientific Students' Association of Manchester; the American Antiquarian Society at Worcester; the Boston Society of Natural History; the American Journal of Science; Prof. Daniel Draper of New York; the New York Entomological Club; the Entomologica Americana, published in Brooklyn; the College of Pharmacy, Engineers' Club, the American Naturalist, Mr. Henry Phillips, Jr., Mr. Philip H. Law; the Philosophical Society of West Chester; the Johns Hopkins University; the American Journal of Philology; the American Journal of Archæology; the Departments of State and of the Interior, the War and Navy Departments; the Smithsonian Institution; the United States National Museum; the United States Fish Commission; the Library of the Surgeon-General's Office; the Catalogue of United States Publications; the Women's Anthropological Society; Mr. J. Hotchkiss of Staunton; the State Historical Society at Iowa City; the Wisconsin State Historical Society, and the University of Minnesota.

Stated Meeting, October 2, 1885.

Present, 4 members.

Vice-President, Dr. RÙSCHENBERGER, in the Chair.

Donations for the Library were received from the Adelaide and Hong-Kong Observatories; Geological Survey of India; K. K. Zoölogisch-botanischen Gesellschaft, Wien; Zoölogischer Anzeiger, Leipzig; Dr. G. vom Rath of Bonn; Universitetet, Lund; Archives Néerlandais; Académie Royale de Belgique; École des Mines, Paris; Zoölogical Society of London; Nature; Cambridge University; Leeds Philosophical and Literary Society; Dun Echt Observatory; Essex Institute; American Journal of Science; New York Meteorological Observatory; Franklin Institute; the American Naturalist; Mr. Henry Phillips, Jr.; Prof. H. Carvill Lewis; Mr. Philip C. Garrett; Johns Hopkins University; United States Naval Institute;

United States National Museum; Department of State; and Mr. William Harden of Savannah.

Letters of acknowledgment were received from the K. Zoölogisch Genootschap, Amsterdam (116) and Register; South Kensington Museum (117, 118, 119); Musée Royale d'Histoire Naturelle de Belgique (92–95, 97–119) and Register; Zoölogical Society of London (117–119), Society of Antiquaries, London (116–119) and Register; Mr. Archibald Geikie of Edinburgh (117, 118, 119); Royal Institution (117, 118, 119); Académie Royale, Amsterdam (112, 114, 115); K. Danske Videnskabernes Selskab (115); Université Royale de Norvège (113–116) and Register; Virginia Historical Society (115, 116); University Library, Cambridge, Eng. (117, 118, 119); Dr. L. G. de Koninck of Liège (116–119); Observatorio Astronómico Nacional Mexicano (116) and Register; Peabody Institute (118); Verein für vaterlandische Naturkunde in Würtemberg (115, 116) and Register; Königliche Bibliothek, Berlin (116) and Register; Smithsonian Institution (116) and Register; K. Sächsische Gesellschaft der Wissenschaften (117, 118, 119); Université Royale, Lund (109–115); Mr. J. F. Garrison of Camden, N. J. (119).

Letters of envoy were received from the Musée Royale d'Histoire Naturelle de Belgique; Verein für Vaterlandische Naturkunde in Württemberg; Université Royale, Lund; American Oriental Society; Colonial Museum of New Zealand; Bataviaasch Genootschap van Kunsten en Wetenschappen; United States Geological Survey; Académie Royale des Sciences, Amsterdam; Sir J. B. Lawes of London; United States Naval Institute; Royal Cornwall Polytechnic Society; Königlich Preussische Akademie der Wissenschaften; Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne; Brooklyn Entomological Society; Geological and Natural History Survey of Minnesota; Manchester Scientific Students' Association; Académie Royale des Sciences, Stockholm; Musée Guimet; Adelaide Observatory; Madras Observatory; University Library, Cambridge, Eng.; Société Hollandaise des Sciences.

Letters were read from the Delaware County Institute of Science, Media, Pa., requesting a copy of No. 119, which was ordered to be sent; from Mr. Joseph Lesley (Princeton, Mass.), dated July 28th, 1885, presenting his resignation from membership on account of ill-health, which was, on motion, accepted; from Josef Menges, Dresden, offering for sale a collection of East African animals; from the Comité Geologique, St. Petersburg, sending its Bulletin and requesting exchanges. On motion the request was granted, to begin with Proceedings No. 117.

From George W. Hough, announcing that his address would be Dearborn Observatory, Chicago; from Prof. T. M. Drown (Easton, Pa.), announcing change of address to Boston, Mass.

Mr. Henry Phillips, Jr., deposited in the Library, the London Numismatic Chronicle, 1885, Part II.

The following deaths were announced:

M. Emile Malezieux (Paris), May 20, 1885, æt. 63.

M. Henry Milne-Edwards (Paris), July 29th, 1885.

M. J. J. A. Worsaae (Copenhagan), August 15, 1885, æt. 64.

George Leib Harrison (Philadelphia), September 9, 1885, æt. 74.

On motion the President, in his discretion, was authorized to appoint a suitable person to prepare the usual obituary notices.

The following papers were presented:

Dr. F. A. Genth, "Contributions from the Laboratory of the University of Pennsylvania. No. XXIV. Contributions to Mineralogy."

Dr. Daniel G. Brinton, "On Polysynthesis and Incorporation as characteristics of American Languages."

Dr. F. S. Krauss (Vienna), "Aus Bosnien und der Hercegovina."

Prof. E. D. Cope, "Catalogue of the Species of Batrachians and Reptiles contained in a collection made at Pebas, Upper Amazon, by John Hauxwell."

Dr. Fr. Meinert, "Myriopoda Musei Cantabrigensis. I. Chilopoda."

Pending nominations Nos. 1049–1063 were read, and the Society was adjourned by the presiding officer.

Stated Meeting, October 16, 1885.

Present, 16 members.

Vice-President, Dr. RUSCHENBERGER, in the Chair.

Donations for the Library were received from the Mining Department, Melbourne; Geological Survey of India; Kongliga Vetenskaps Societeten, Upsala; Kongelige Nordiske Oldskrift Selskab, Copenhagen; Königlich Sächsische Gesellschaft der Wissenschaften, Leipzig; Kaiserliche-Königliche Geologische Reichsanstalt, Wien; Naturhistorische Gesellschaft, Nürnberg; Physikalisch-Ökonomische Gesellschaft, Königsberg; Naturhistorische Gesellschaft and Messrs. Oberlehrer L. Mejer and Fr. Reinhold of Hannover; Musée Royal d'Histoire Naturelle and Académie Royale des Sciences, &c., de Belgique; Institution Ethnographique and Prof. Leon de Rosny of Paris; Royal Asiatic Society of Great Britain and Ireland; the Royal Society, Forestry and Mr. William Blades of London; Rev. C. W. King of Cambridge, England; the Brooklyn Library and Mr. J. B. Smith, Editor of Entomologica Americana; College of Pharmacy, Prof. E. D. Cope and Messrs. Henry Phillips, Jr., and E. A. Gieseler of Philadelphia; the United States National Museum, Dr. A. S. Gatschet and Mr. J. H. Hickcox, publisher, of Washington; Mr. Charles C. Jones, Jr., of Augusta; Chicago Historical Society; Rev. Stephen D. Peet; State Historical Society, Iowa, and the State Historical Society of Wisconsin.

Letters of envoy were read from the K. Sächsische Gesellschaft, Leipzig; Naturhist. Gesellschaft zu Hannover; Société Royale des Sciences à Upsal; Meteorological Office, London, U. S. Naval Observatory, Washington, D. C.; Elliott Society of Science, Charleston, S. C.

Letters of Acknowledgment were read from K. K. Central Anstalt fur Meteorologie und Erdmagnetismus, Vienna (117, 118, 119); Naturforschende Gesellschaft, Emden (117, 118, 119); Société Royale des Sciences, Upsal (113, 114, 115, 116 and Register); R. Accademia dei Lincei, Rome (116 and Register), and requesting certain old numbers of Proceedings and Transactions (Procs. I—VI, XII, Trans. O. S., I—IV, N. S.

I—XI, XIII);* Chemical Society of London (117, 118, 119); Geological Survey of India (117, 118, 119); Kon. Zoolog. Genootschaf, Amsterdam (117, 118, 119); Société Hollandaise des Sciences, Harlem (117, 118, 119); Fondation de P. Teyler van der Hulst, Harlem (116); Horatio Hale, Clinton, Ontario (119); Geological Survey of Canada, Ottawa (116, 119); Numismatic and Antiquarian Society of Philadelphia; University of the City of New York (N. Y.); American Antiquarian Society, Worcester (Mass.); New York Hospital (N. Y.); Yale College Library (New Haven, Conn.); Essex Institute (Salem, Mass.); U. S. Military Academy (West Point, N. Y.); Wyoming Historical and Geological Society (Wilkes-Barre, Pa.); Cincinnati (Ohio) Observatory; Leander McCormick Observatory (University of Virginia); University of Toronto (Canada); Vassar Brothers Institute (Poughkeepsie, N. Y.); Boston Athenæum; Cornell University Library (Ithaca, N. Y.); University of California; Surgeon-General, U. S. A. (Washington, D. C.); Public Library (Boston Mass.); California Academy of Sciences (San Francisco, Cal.); Museum of Comparative Zoölogy (Cambridge, Mass.); Pennsylvania, Connecticut, Virginia, Georgia, Wisconsin, New Hampshire, New Jersey, Chicago (and all previous numbers), Maryland, and Kansas State Historical Societies; Prof. John J. Stevenson, New York (N. Y.); Prof. J. W. Moore, Easton (Pa.); Prof. J. M. Hart, Cincinnati (Ohio); Henry Phillips, Jr. (Philadelphia); J. H. C. Coffin (Washington, D. C.).

Mr. William Morris Davis presented to the Cabinet ten French bronze Medals, of which he furnished the following description:

MEDALS.

No. 1. The dead Napoleon. Reverse, the Arch of reception at Rouen, and draped steamer. Struck in 1840 in commemoration of the removal of Napoleon's remains from St. Helena, and restoration to France.

No. 2. Napoleon le Grand. Reverse, arch of triumph, motto, "A l'Armée Française."

No. 3. Ferdinand Philippe Louis, Duc d'Orleans. Obverse, commemorative, "Chapelle Saint Ferdinand.

No. 4. Marie d' Orleans. Obverse, "Statue de Jeanne d'Arc."

* Referred to Secretaries with power to act.

No. 5. "Cathedrale de Paris." Reverse, "ground plan with details of dimensions," &c.

No. 6. Liberty enlightening Justice, with Despotism prostrated. Motto, "Revolution de 1848." Reverse, "Gouvernement Provisoire," with names of the ministers, &c.

No. 7. Head emblematic, surrounded with heavy wreath of oak and laurel. Motto, "Republique Francaise." Reverse, three figures, "Liberté, Egalité, Fraternité, 24 Fevrier, 1848."

No. 8. A figure of Liberty, looking back, hand supporting a tablet, inscribed, "Droit de l' Homme et du Citoyen." Motto, "Republique Francaise." Reverse, arraignment of royal government, and sustaining the three revolutions, 1789, 1830 and 1848.

No. 9. The three heads of Adam Mickiewicz, Jules Michelet and Edgar Quinet. Reverse, motto, "Ut omnes unum sint," "La France et les auditeurs du college de France, 1844, 1845."

No. 10. Head of Pierre Jean de Beranger. Reverse, is remarkable for its fine lettering of the titles of songs of Beranger. The design is an antique harp, surrounded by rays as from a sun; alternating with the rays is the following list (enclosed in a circle of two inches):

1. Adieu Chansons.
2. Le Roi d'Yvetot.
3. Maudit Printems.
4. Le Vieux Drapeau.
5. Vieux habits vieux galons.
6. Louis XI.
7. Prediction de Nostradamus.
8. La bonne vieille.
9. Le Dieu des bonnes gens.
10. Le Juif errant.
11. Les etoiles que filent.
12. Le Senateur.
13. Les enfans de la France.
14. Le Grenier.
15. Le tailleur et la fée.
16. L'echelle de Jacob.
17. L' aveugle de Bagnolet.
18. Les Hirondelles.
19. Les esclaves Gaulois.
20. Brennus.
21. Les tombeaux de Juillet.
22. Les Bohemiens.
23. Le Marquis des Carabas.
24. La Vivandiere.
25. Les Souvenirs du peuple.
26. Les Vendanges.
27. A mês amis devenues Ministres.
28. Les Gueux.
29. Les deux sœurs de charite.
30. Le Champ D'asile.
31. Les Contrabandiers.
32. Roger Bontemps.

[in all 487 letters].

The death of James McFarlane, Towanda, Pa., October 12, 1885 (born Sep. 2, 1819), was announced and on motion the President was authorized to appoint at his discretion a suitable person to prepare an obituary notice.

Prof. Cope presented for the Transactions a paper "On the Species of Iguaninæ," which was referred to Messrs. Koenig, Horn, and Harrison Allen.*

* Reported on favorably, Nov. 20, 1885.

Prof. Cope presented for the Proceedings the following papers:

1. On the Structure and Affinities of three Species of Fishes from the Eocene of Wyoming Territory.*

2. Report on the Coal deposits near Zacualtipan, Hidalgo, Mexico.

3. On the Structure of the Brain and Auditory Apparatus of a Theromorphous Reptile, for which a plate was desired.

Prof. Houston presented his views on the origin of earthquakes as shown by the late great explosion of dynamite (285,000 lbs.), at Flood Rock, Hell Gate, upon which a discussion ensued, participated in by Messrs. Davis, Koenig, and Cope.

This being the stated evening for balloting for candidates, the following gentlemen were declared duly elected members of the Society:

1049. William John Potts, Camden, N. J.

1050. Prof. Scheele de Vere, University of Virginia.

1051. Prof. Edwin North, Hamilton College, Clinton, N. Y.

1052. W. J. A. Bonwill, M. D., 1721 Locust St., Philadelphia.

1053. Thos. M. Cleemann, C. E., 2125 Spruce St., Philadelphia.

1054. Horace Jayne, M. D., 1836 Chestnut Street, Philadelphia.

1055. Dr. Hermann Rollett, Stadt-Archivär, Baden bei Wien.

1056. Tommaso Cannizzaro, Messina, Italy.

1057. Everard F. im Thurn, M. A., Pomeroon river, Georgetown, British Guiana.

1058. Prof John Pomialowsky, Secretary of La Société Imperiale d'Archeologie Russe, St Petersburg.

1059. Dr. Ernest Haeckel, Jena.

1060. Prof. Dr. Josef von Lenhossek, Buda Pesth, Hungary.

1061. Prof. Louis Pasteur, Paris.

1062. Prof. Giuseppe Sergi, Università Roma, Rome, Italy.

1063. Prof. Dr. Leopold von Ranke, Berlin.

Nominations Nos. 1064, 1065, 1066, were read, and the meeting was adjourned by the presiding officer.

* Withdrawn by consent, Nov 6, 1885.

Errata in paper by Augustus R. Grote.

In the Proceedings American Philosophical Society, No. 114.

Page 136, line 30 for "are quite highly" read "are often quite highly."
" 137, " 8 for "one" read "our."
" 142, " 11 for "Andela" read "Audela."
" 142, " 17 for "Derideus" read "Derideus."
" 145, " 9 for "Trabulis" read "Trabalis."
" 145, " 26 for "Euthea" read "Enthea."
" 148, " 18 for "Tota" read "*F*ota."
" 150, " 5 for "Viasica" read "Viatica
" 150, " 37 for "Bettumei" read "Bet*hun*ei."
" 151, " 33 for "Sarena" read "Surena."
" 153, " 1 for "Hulotia" read "Hulstia."
" 153, " 12 for "Adrena" read "Advena."
" 153, " 34 for "Trileuca" read "**Trileuca**;" this is a generic title proposed for *Rectifascia* and allies.
" 154, " 39 for "was then" read "*h*as them."
" 159, " 10 for "Scole" read "*I*cole," and for "Sole" read "*I*ole."
" 164, " 24 for "nine" read "more."
" 168, " 35 for "W. W. Hall" read "W. W. Hill;" the genus is named for my friend Mr. Hill, of Albany, the well-known Lepidopterist.
" 169, " 26 for "Tota" read "*F*ota."
" 169, " 2 from bottom for "Arnata" read "Armata."

There are a few other errata to be noticed, but they will have been readily detected by students using the article of which I regret not to have been able to read the proofs.

A. R. G.

him the communication, description, or model, except the officer to whom it shall be entrusted; nor shall such officer part with the same out of his custody, without a special order of the Society for that purpose.

6. The Society, having previously referred the several communications from candidates for the premium, then depending, to the consideration of the twelve counsellors and other officers of the Society, and having received their report thereon, shall, at one of their stated meetings in the month of December, annually, after the expiration of this current year (of the time and place, together with the particular occasion of which meeting due notice shall be previously given, by public advertisement) proceed to final adjudication of the said premium; and, after due consideration had, a vote shall first be taken on this question, viz.: Whether any of the communications then under inspection be worthy of the proposed premium? If this question be determined in the negative, the whole business shall be deferred till another year; but if in the affirmative, the Society shall proceed to determine by ballot, given by the members at large, the discovery, invention or improvement most useful and worthy; and that discovery, invention, or improvement which shall be found to have a majority of concurring votes in its favor shall be successful; and then, and not till then, the sealed letter accompanying the crowned performance shall be opened, and the name of the author announced as the person entitled to the said premium.

7. No member of the Society who is a candidate for the premium then depending, or who hath not previously declared to the Society, that he has considered and weighed, according to the best of his judgment, the comparative merits of the several claims then under consideration, shall sit in judgment, or give his vote in awarding the said premium.

8. A full account of the crowned subject shall be published by the Society, as soon as may be after the adjudication, either in a separate publication, or in the next succeeding volume of their Transactions, or in both.

9. The unsuccessful performances shall remain under consideration, and their authors be considered as candidates for the premium for five years next succeeding the time of their presentment; except such performances as their authors may, in the meantime, think fit to withdraw. And the Society shall annually publish an abstract of the titles, object, or subject matter of the communications, so under consideration; such only excepted as the Society shall think not worthy of public notice.

10. The letters containing the names of authors whose performances shall be rejected, or which shall be found unsuccessful after a trial of five years, shall be burnt before the Society, without breaking the seals.

11. In case there should be a failure, in any year, of any communication worthy of the proposed premium, there will then be two premiums to be awarded the next year. But no accumulation of premiums

shall entitle the author to more than one premium for any one discovery, invention or improvement.

12. The premium shall consist of an oval plate of solid standard gold of the value of ten guineas. On one side thereof shall be neatly engraved a short Latin motto suited to the occasion, together with the words: "The Premium of John Hyacinth de Magellan, of London, established in the year 1786;" and on the other side of the plate shall be engraved these words: "Awarded by the A. P. S. for the discovery of———A.D.———." And the seal of the Society shall be annexed to the medal by a ribbon passing through a small hole at the lower edge thereof.

SECTION 2. The Magellanic fund of two hundred guineas shall be considered as ten hundred and fifty dollars, and shall be invested separately from the other funds belonging to or under the care of the Society, and a separate and distinct account of it shall be kept by the treasurer.

The said fund shall be credited with the sum of one hundred dollars, to represent the two premiums for which the Society is now liable.

The treasurer shall credit the said fund with the interest received on the investment thereof, and, if any surplus of said interest shall remain after providing for the premiums which may then be demandable, said surplus shall be used by the Society for making publication of the terms of the said premium, and for such purposes as may be authorized by its charter and laws.

The treasurer shall, at the first stated meeting of the Society in the month of December annually, make a report of the state of said fund and of the investment thereof.